Doctoral Dissertation

User-Centered Problem-Based Learning at Learning Commons: Exploration of a Unique Learning Pedagogy in Academia

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Abstract

Learning Commons and learning are inseparable. The twenty-first century digital technologies have challenged the library services and resources and as well as it has changed the user behavior due to its service use aspect. Users of academic libraries are now very technology efficient and network or Internet dependent for their learning and information needs. These Techie Gen users are demanding wider access to digital resources and expecting interactive spaces for learning. It has been noted that there is a growing trend among the learners as they are becoming habituated to study in groups outside of the classroom spaces. Therefore, libraries have adopted a user-centric approach due to its learning and resources. They are redesigning its spaces and resources and introducing learning commons (LC) to accommodate the twenty-first century learning behavior of the user students. It is a unique service from the library where librarians, commons staff, student tutoring staff collaborate and interact with users (for learning by teaching) for their coursework assignment, presentation, research, writing report, technical support, program on information literacy, faculty development, and so on. LC is a super hub for learning in academic libraries where problem-based learning (PBL) method supported learners can collaborate for self-responsible user-centered learning, group learning and informal learning for out of class course work problem solving. During group learning users` transformer role for knowledge sharing and acquisition has been determined as the confirm PBL cycle phase in LC. Thus, LC has created a unique user-centered learning (UCL) pedagogy in academia. The purpose of this thesis is to contribute to a better understanding of these consequences. It tries to explain the user learning in terms of how it relates to the PBL supported learning commons for creating an extensive and time-befitting user-centered learning environment.

Taking into account the above challenges, the main objective of the research is to develop an integrated theoretical model of user-centered learning at learning

commons. For answering the research questions, the study reviewed literature on major issues of learning and LC. We have conceptualized that LC supports problem-based learning (PBL) in an out of class space where knowledge sharing and acquisition plays a transformer role for solving learning issues of the learners and completing their learning.

For examining and exploring the outcome from a large research population, the study employed a quantitative research approach and took the survey design within its methodology. To reach the LC users at their convenience an online survey was conducted within Japan Advanced Institute of Science and Technology (JAIST), Kanazawa University and Nagoya University of Japan. Based on the PBL method, the survey was on LC use for learning, role of knowledge sharing and acquisition in group learning and out of class informal learning for course work problem solving. The study adopted Partial Least Squares – Structural Equation Modeling (PLS-SEM) method to analyze the survey data and to examine the variables and their interaction with the dependent variable. PLS-SEM employed a two-step model validation procedure, first examining and validating the measurement model and then testing the proposed theoretical structure, as stated in this technique. The results show that learning commons (LC) completely supports problem-based learning in an out of class space and it is one of the main learning methods in this space. User learners are pursuing their self-responsible learning and using the LC continuum of services. Users` knowledge sharing and acquisition plays a vital role for solving learning problems in the group learning process and it has been determined as a must PBL phase for LC. Lastly, the users showed a great interest in PBL based informal learning for solving their coursework learning problems. Finally, the study suggests that the learning commons of academic libraries should have to think about the PBL method in its environment for user-centered learning. They have to redesign its paces and services, and redefine the librarians, LC staff, tutoring staff role for user-centered learning (UCL) at LC based on the theoretical model and implications of the study.

Keywords: Learning Commons, Problem-Based Learning, Knowledge Sharing and Acquisition, User-Centered Learning, Continuum of Learning.

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Chapter 1: Introduction

1.1 Introduction

Academic libraries uphold and support the academic life of an educational institution and play a role as an activator in the learning process. For a long time academic libraries have been treated as the soul of academic institutions. It develops a link between users and a variety of information (Freeman, 2000). For a long time, library experts have identified that technology and user expectations are playing a dominant role for reshaping the services of academic libraries (Allen, Mullins & Hufford, 2007). Survey shows that users of this age are not using the library in the same way as they have used in the past due to technological flexibility (Gardner & Eng, 2005). The traditional roles and functions of academic libraries have become outdated due to technological advancements (Lee & Schottenfeld, 2014). Currently libraries are facing a number of unprecedented challenges like alternative body of library, declining user numbers, fall of circulation and lesser seat occupancy, transition into digitalization and squeezing budget (Akeroyd, 2001; Johnson & Lilly, 2012). Academic libraries need to face those challenges. Users of academic libraries are now very technology efficient and network or Internet dependent for their information needs. Therefore, the current library users are mentioned as the 'Techie Generation' (TechieGen). These TechieGen users are demanding wider access to digital resources and expecting interactive spaces for their learning (Thomas & McDonald, 2005). As a result, libraries are redesigning their facilities and creating services with the collaborative relationship among the librarians, teachers and users.

For nearly the last four decades digital technologies have challenged the library services and resources and as well as it has changed the user behavior due to its service use aspect. Libraries are dealing with a new generation of Internet users that are technologically sophisticated and integrate information access and use into every aspect of their life to unprecedented levels (Thomas & MacDonald, 2005). From then libraries have been adapting their collections, services, and surroundings to the digital world (Lippincott, 2005). The present trend of the library is to adjust toward digital collection and adopting web 2.0 based social networking services and merging the traditional print resources with

the hybrid digital resources and making it as a blended library (Jankowska & Marcum, 2010).

Change is constant in the wider institutions and libraries are no exception. The core of library technology change was that of the adoption of Khasawneh, 2013 based operations and services for the user. It's a library service model that supports constant and deliberate change, enabling users to participate in the construction of both physical and virtual services they want, and it also tries to attract new users and better serve existing ones by enhancing customer-driven solutions (Casey & Savastinuk, 2006). It has introduced a digital revolution in today's libraries. Library 2.0 works on the creation of content and services, the availability of multimedia materials, and the implementation of synchronous and asynchronous means for users to communicate with each other and librarians (Baryshev, Verkhovets & Babina, 2018).

The twenty-first century technology and network innovation are reshaping the communication and interaction of libraries and its users. The smart library is about a reality where web and digital libraries have a symbiotic relationship that makes information transmission easier and more convenient (Gul & Bano, 2019). Traditional libraries can become smart libraries through strategic design and implementation of advanced technologies such as cloud computing, data mining, and artificial intelligence (Cao, Liang & Li, 2018). The smart library gathers data about its patrons and analyzes their biographical information, questions, and search history (Baryshev, 2021). A smart library is more than simply a technical foundation; it's also a service concept aimed at offering high-quality service and a positive user experience (Cao, Liang & Li, 2018). But all those technological changes will become meaningful when it will reach the users virtually and physically to meet their diversified demand.

Academic libraries of the twenty-first century are undergoing a transformation due to its changing nature of services and upcoming challenges (Lewis, 2007). Lewis (2007) affirms that academic libraries are facing challenges due to migration of print to electronic collection, retirement of print collection, introduces informal learning space, redefining library and information tools and migration for purchasing to curating content. All those challenges are reshaping the academic library with the blending of today`s smart library. Change is persistent in the library, and it is the responsibility to them to respond quickly with the proper plan and design to manage the ever changing needs of the users.

Academic libraries are now in a paradigm shift from information resource-centric view to user-centric approach (Scupola & Nicolajsen, 2010). It is evident that learners today have fundamentally altered their learning needs/styles, together with the cumulative advances and breakthroughs in digital technology (Doiron & Asselin, 2011). It has been noted that there is a trend among the learners as they are becoming habituated to study in the out of classroom environment. To encourage students to continue their study beyond the classroom, libraries provide collections, organized information, methods that enhance access, and in-person and virtual help (Lippincott, 2005). Academic libraries need user-centered change of its services, collection, and spaces for accommodating the learning and research within the technological advancements. Survey shows that the learning style of students has a growing relation with the learning space. So, the study takes the lens of user learning for redefining its services and resources.

From the very beginning libraries and learning have always been inseparable (Bennett, 2009). Libraries must design learning spaces that optimize the confluence of the TechieGen, contemporary learning theory, and information technology in order to best serve the educational enterprise (Brown, 2005). Social interaction has become a high preference of today`s learners and they want to learn in collaboration in out of class spaces. Students in the Techie Generation are social and team-oriented, comfortable multitasking, and typically upbeat in their perspective and want to make their own content that is aided by the IT resources available to them (Brown, 2005). Now learning has become social and library spaces encourage informal learning and research for creating meaning in solving issues. Designing informal learning spaces is quickly becoming a hot topic of discussion and innovation (Milne, 2006). These days, academic libraries are reshaping their spaces and introducing Learning Commons (LC) service to meet the diverse needs of user learning. Flexibility, openness, and IT advancements that enable to establish zones that may be utilized by groups or people as wanted are the key themes of such spaces, particularly in learning commons or classrooms (Khasawneh, 2013). Informal learning at LC supports problem-based learning (PBL) of Constructivist learning theory where learners create and share knowledge during solving learning problems in collaboration.

The literature highlights that libraries are managing technological changes within its services and resources. They also took the opportunity to redesign its spaces for the learning of its users. Accordingly, this research highlights how problem-based learning

(PBL) user students are pursuing out of class learning at LC and creating and acquiring knowledge for solving learning problems.

1.2 Statement of the Problem

Academic libraries are the impartial part of the academic institutions for accelerating learning in academia. They are now in a paradigm shift from information resource-centric view to user-centric approach (Scupola & Nicolajsen, 2010). Currently they are facing a number of challenges like declining user numbers, fall of circulation and in-house use, transition into digitalization, continuous adoption of IT and squeezing budget (Alam, Yoshida & Kohda, 2016). Learning needs of library users is ever changing, and it is compelling the libraries to redesign their services according to users' wants. Users are expecting interactive and collaborative spaces for their learning in the library. To meet the diverse needs of users' learning, academic libraries introduced Learning Commons (LC) service. LCs are the interactive and collaborative spaces in the library which combines other library services, LC resources and staff. It has been considered as a platform and a super hub for informal learning in academia.

Learning commons is a group space where users come by themselves to solve their learning problems in collaboration. It has been a new phenomenon in academia where users engage them in a self-regulated manner. Also the library authority combines their resources so as the users can engage in their problem solving procedures without any hurdle. They integrate physical commons, virtual commons, and cultural commons resources for learning of the users. For creating meaning in learning LC users integrate their learning method for solving the learning problems in an out of class space. It is the learning method of the users which they integrate with the LC offered resources for solving their learning problems. Libraries already have studied to manage the technological changes of the TechieGen users and adopted innovative services of Library 2.0. Now they are heading to manage the smart library environment with its recent technologies. Studies show that technology-based services and learning in libraries are inseparable (Bennett, 2009; Brown, 2005; Gul & Bano, 2019; Khasawneh, 2013; Lippincott, 2005). In both classrooms and libraries, technology-enhanced active and collaborative learning environments are becoming increasingly popular for group content (Lee & Schottenfeld, 2014). For this purpose, this research takes the lens of learning in

an out of class space of LC. Libraries have redesigned their spaces and introduced collaborative places for learning. User students are using this space for their self-responsible learning. They are using problem-based learning (PBL) phases for creating and sharing knowledge and solving their coursework problems.

As an informal learning space LC has introduced an emerging learning pedagogy by offering together users own learning, knowledge sharing and acquisition and problem-based learning (PBL) method for problem solving. Using these three constructs together, we frame the challenge for the current study from the theoretical perspective of how problem-based learning study and knowledge creation and sharing is constructing user-centered learning pedagogy at learning commons.

1.3 Objectives and Research Questions

1.3.1 Research Objectives

Earlier research indicates that learning activities of PBL are supported by LC which encourages users to engage in an out of class environment (Brown, 2005; Gillette & Somerville, 2006). But the problem statement identifies some significant areas where this present study attempts to contribute. Librarians have designed LC spaces for facilitating students` self-responsible own learning without considering any learning method like PBL. Moreover, there is an emerging learning pedagogy based on knowledge sharing and acquisition where students are playing the role of knowledge transformer in LC spaces which libraries are not aware about. LC has introduced user-centered emerging learning pedagogy which need to be identified for the extended use of its redesigned spaces, services, and resources. Aiming to investigate all these major issues, the present study focuses the following major objectives;

- To explore how learning commons (LC) and users are constructing problem-based learning (PBL) supported user-centered learning (UCL) in academic libraries.
- To propose problem-based learning (PBL) supported theoretical models for supporting user-centered learning (UCL) at learning commons.

1.3.2 Research Questions

To achieve the objectives and investigate the major issues, this research has the following Major Research Questions (MRQ) and three Subsidiary Research Questions (SRQ):

MRQ: How do learning commons (LC) is constructing problem-based learning (PBL) supported user-centered learning (UCL) in academic libraries?

SRQ1: How do LC continuum of services are used for user-centered (self-responsible) learning?

SRQ2: How does learners` transformer role in group learning knowledge sharing and acquisition at LC solve learning problems?

SRQ3: How does problem-based learning (PBL) phases support out of class informal learning at LC?

1.4 Significance of the Research

The popularity of using Learning Commons among the student learners of academic libraries for out of class own learning and their transformer role for knowledge sharing and acquisition in PBL phases for solving coursework problems is investigated in this study. The research is noteworthy in several ways.

Firstly, learning commons is a collaborative space in academia where learners gather to work in groups. Learning commons provide physical, technological, social and intellectual spaces and offer learners, researchers and information professionals to pursue numerous learning and research curricula and activities (Bailey, 2006). Most of the studies have focused on the relationship of space and learning (Gillette & Somerville, 2006; Khasawneh, Shibayama, Kato, Mori & Taniguchi, 2011; Nitecki & Simpson, 2016). Therefore, this study is a timely addition to these, with a focus on the use of LC continuum for users' own learning.

Secondly, LC is a facilitator for users to engage them in active learning in an out of classroom environment and helps them to construct knowledge by solving learning problems. This collaborative setting not only allows students to unlock their capacity to manage and produce their own knowledge, but it also enriches social learning and living (Oliveira, 2018). LC offers collaborative and interactive learning spaces where group

processes create and share knowledge for solving learning issues. It is a unique phenomenon in the LC space which has been overlooked for long in the LC learning process. Therefore, the findings of the present study will be significant with evidence that learner`s transformer role for knowledge sharing and acquisition helps in learning problem solving.

Thirdly, as an informal learning space, LC has introduced an emerging learning pedagogy by collaborating multiple support units and tutoring and learning services. Users` learning at LC supports PBL phases in an out of class environment. Problem-based learning (PBL) of constructivist theory encourages learners to construct knowledge based on the experience of solving problems (Brown, 2005). Therefore, the present research adopts knowledge sharing and acquisition as a phase of PBL in LC and enables thereby further theorizing of PBL cycle phases in LC learning perspectives.

Finally, additional multidisciplinary fields, such as self-regulated learning at LC, information literacy and learning value co-creation in the library service system can benefit from this study.

1.5 Methodology

The goal of this study was to see if there is a link between learning commons (LC) use and problem-based learning (PBL) in an out of class environment learning in academic libraries. To uncover significant characteristics of links between the two, a comprehensive assessment of the literature on LC and PBL was conducted.

For the empirical analysis of this novel phenomenon the study has undertaken quantitative method approach for addressing the objectives and research questions with statistical data. In checking the problem-solving practices of users during learning at LC we have employed the quantitative method for data collection and analysis. Partial least squares-structural equation modeling (PLS-SEM) were used to analyze the quantitative data.

The research uses mainly two cases from Japan and included another one with personal interest. Finally, there are three university form Japan, the Japan Advanced Institute of Science and Technology (JAIST), the Kanazawa University and the Nagoya University. Other than that, there are some other universities included in the survey as the respondents were available in Japan as Intern or Special students of those three universities. The other

cases universities are the Central European University (Kosovo), Mount Royal University (Canada), New Platz State University of New York (USA), South West University of Science and Technology (China) and University Toulouse (France).

Data were collected through questionnaire survey from the three Japanese universities and used the Google Drive platform as an online survey collection tool. A structured questionnaire was developed to collect responses from the respondents. The survey data analysis explicitly addresses subsidiary research questions (SRQ) 1, 2 and 3 specifically.

1.6 Definition of Research Terms

Learning Commons

Learning Commons (LC) provide physical, technological, social and intellectual spaces and support learners to pursue learning and research activities (Bailey, 2006). Learning in LC is a process of collaboration and interaction among the learners, tutoring staffs, faculty, information technologists, learning contents and peers (Alam, Yoshida & Kohda, 2016). It supports PBL methods by confirming out of class activity for identifying, formulating, searching and solving learning problems (Khasawneh, 2013).

Learning

Learning before 1900 was mostly based on memorizing; now, it is primarily based on understanding (Brown, 2005). Learning is an active process in which learners construct new ideas or concepts based upon their current and past knowledge (Bruner, 1990). From the psychological perspective learning has been characterized both functionally and mechanistically as changes in behavior that occur as a result of experience (De Houwer, Barnes-Holmes & Moors, 2013).

Constructivist Learning

Constructivist theory holds that learners construct knowledge by understanding new information building on their current understanding and expertise (Brown, 2005). The theory implies that learning is best served when it is contextual, active, and social (Brown, 2005).

Problem-Based Learning (PBL)

Problem based learning (PBL) is an instructional method in which students learn through facilitated complex problem that does not have a single correct answer (Hmelo-Silver, 2004). PBL develop learning skills such as solving complex problems, thinking critically, analyzing, and evaluating information, working cooperatively, and communicating effectively (Duch, Groh, & Allen, 2011; English & Kitsantas, 2013). PBL engage students in active learning and helps them to become self-directed and self-regulated learner (Savery, 2006).

Knowledge Sharing and Acquisition

During learning new information is assimilated into the learner's knowledge paradigm to create knowledge (Brown, 2005). Lauriden and Cruz (2013) has stated that, ``Learning is the acquisition of knowledge. Sharing is a way of attaining new knowledge among learners``. Knowledge sharing among the learners makes the learning happens. The success of collaborative learning like LC largely depends upon the students' attitude toward sharing information and knowledge (Majid & Chitra, 2013). In PBL process students learn and solve course work problems by sharing and acquisitioning of knowledge in engagement.

LC User

In general term, users of a library are the regular consumer of its resources and services. In academic library, users do not reflect a single category, they are the undergraduates, postgraduates, researchers, teachers, and external users from a variety of fields including the general public (Carr, 2006). But in the context of learning commons of academic libraries, we have conceptualized LC user for this study. LC users are the student learners who use this space for their self-responsible, group or informal learning for course work or individual problem solving.

Academic Library

The academic library has been known as the "heart" of the learning community since it allows students and faculties to do research and expand their knowledge (Simmonds & Andaleeb, 2001). The aim of an academic library is to support learning and research needs

and interests of the users in academia. For the present study we have chosen university libraries as an academic library among the several types of academic libraries.

1.7 Chapter Outline of the Dissertation

The research is summarized in this chapter. It contains the precise research questions as well as the study's objectives. It also describes the research's relevance, as well as the scope and constraints of the endeavor. The dissertation consists of five chapters.

Chapter 1: Introduction

It comprises the introduction and explanation of the problem statement of the study. Also includes the specific objectives and research questions of the phenomenon.

Chapter 2: Literature Review

This chapter is distributed into seven sections including Commons, Information Commons and Leaning Commons. Also included the Transformation of Information Commons (IC) to Learning Commons (LC), Constructivist Learning Theory and its relationship with LC, and the Collaborative learning, User-Centered Learning at LC, and Knowledge Creation and Sharing. Problem-Based Learning (PBL) at LC and its cycle phases for PBL process learning.

Chapter 3: Research Methodology

It explains how the Problem-Based Learning phenomena in Learning Commons was studied using a systematic methodology. It covers the intellectual groundworks of the research paradigm, as well as justifications for sample selection and explanations for data collecting implementation.

Chapter 4: User-Centered Problem-Based Learning at Learning Commons

This chapter focuses on Problem-Based Learning at Learning Commons. It presents the findings from the quantitative survey conducted on in three university students of Japan. The findings mainly evident the constructs that LC are used for learners own learning, PBL is supported by LC, and users are in transformative practice of Knowledge Sharing and Acquisition in LC PBL phases.

Chapter 5: Conclusion and Implications

Finally, this chapter gives a synopsis of the research, findings to the research questions, and research implications, including limitations and future work scope.

Chapter 2: Literature Review

2.1 Introduction

The literature review of this chapter explores the pedagogy that has taken place in users` learning in out of classroom spaces in the context of collaboration at Learning Commons (LC). This review is to identify the gap in the research and placing insight in the present study in the perspective of past studies. Through reviewing the existing literature of Learning Commons, Problem-Based Learning (PBL), Self-Directed Learning (SDL) and knowledge sharing, the present chapter will determine and create a research space. The evaluation procedure will assist in the development of a good comprehension in order to shed light on the dissertation's issue statement. The review starts with a general overview of the associated literature from a wide range of standpoint. Then it moves on to more exact or confined investigations that are increasingly focused on the definite issues just around the corner.

The first section is a review of the Learning Commons and how it has to be used by the learners of academia. The discussion is then followed by the Learning Commons phenomenon in the context of collaborative learning of library users. After that the ramifications of Learning Commons with users` course studies, problem solving practice in problem-based learning (PBL) and understanding of knowledge sharing and acquisition trends are going to be reviewed. The final section examines self-directedness of users to come to use the LC from the perspective of Self-Directed Learning (SDL) for checking the user-centered learning (UCL) pedagogy at LC. The learned gaps in the literature will also be used to justify the current investigation.

2.2 Commons

Commons is the core focus of Learning Commons. But the term does not always indicate that, and it has some other meaning from different perspectives. In general the Wikipedia (``Commons,`` 2020) has described the Commons as the cultural and natural resources that are available to all members of a community, such as air, water, and a habitable planet. These are the shared resources rather than privately owned. On the other hand, in

connection with this study from the perspective of a library, the term "commons" refers to a collection of resources, services, and venues whose core focus is research. It`s broader viewpoint emphasizes integrated and participatory teaching, learning, and research (Bailey, 2014). In this research we have accepted this definition as a lens of the study.

Due to the advancement of information technology and wider variation in user demand, academic libraries have adopted Commons as an option for change management in services and resources (Cowgill, Beam & Wess, 2001). For a long library and information professionals are used to the culture to embrace change and innovation and they have embodied and nourished the commons - information, learning, research, and teaching in the libraries (Bailey & Tierney, 2008). Which later directed them to introduce a new service line - Information Commons for information and research of the users.

2.3 Information Commons (IC)

In the mid 1980`s, academic libraries of North American educational institutions have seen the emergence of a new model of service delivery for its users and most of the cases the model was mentioned as the Information Commons (IC) (Beagle, 1999). The model is based on the ``integrated library public services`` implementations models which has covered numerous service areas and this implementation process has been referred as Information Commons (Bailey, 2006). At that period academic libraries of North American were anxious about their future because of declining gate counts, unfilled reading-rooms and reduced circulation (Beagle, 2002). To overcome the situation and to survive for the future, academic library experts started to re-think about the condition. They have started to focus on a patron-centered, learner-centered, user-friendly service delivery system for information and research (Bailey, 2006; Somerville & Collins, 2008). It has focused on renovating the library and more specifically re-designing the services (Applegate, 2009). As a result, the IC was introduced to overcome the situation.

The information commons have arisen as a new and crucial way for users to access resources and services (Cowgill, Beam & Wess, 2001). It is broadly defined as a model for providing integrated access to electronic information resources, multimedia, print resources, and services to students (Bailey & Tierney, 2008). In his sensational writing Beagle (1999) mentioned that Information Commons has been used on two parallel levels.

On first level, it's been used to describe an entirely online environment in which the digital services may be accessible through a single graphical user interface (GUI) and potentially searched from any networked workstation (Beagle, 1999). On a second level, the term refers to a new sort of physical facility that is expressly built to organize workspace and service delivery for an integrated digital environment. As a physical structure, the Information Commons could be a department or floor of a big academic library (Beagle, 1999). It is a single spot where users may locate resources (e.g., on how to write a paper or solve a computer or network problem), access multiple databases (both indices and full-text) or the library's online catalog, visit websites through Internet, and use selected research tools (Bailey & Tierney, 2008).

Basically, information commons were designed to facilitate information literacy instructions for faculty and users. But later IC took the students` learning priority in services and converted from Information Commons to Learning Commons (Beagle, 2009).

2.3.1 Transformation of Information Commons (IC) to Learning Commons (LC)

The Information Commons (IC) model was being expanded outside of the information literacy rubric to include collaboration with other learning-related campus units like tutorial programs, writing centers, faculty development centers etc. and this new expanded model was distinguished with a designation of Learning Commons (LC) (Beagle, 2008). All features of the information commons are included in a learning commons, but they are expanded and enhanced (Bailey & Tierney, 2008). After successfully effectuating IC, libraries expanded their services and facilities to host collaborative learning support programs, renaming them LC (Beagle, 2008). Both provide resource-rich environments in which students can develop certain skills that are fundamental to a liberal education (Bennett, 2003).

2.4 Learning Commons (LC)

With the advancement of rapid technological changes and its high acceptance by the ‘Techie Generation’ (Techie Gen) library users, libraries are now in paradigm shift regarding their spaces, collections and services. Over the last three decades, academic

libraries are embracing a new model of service delivery system which is referred to as Learning Commons (LC). Academic libraries are trying to convert them into social, cultural and technological centers by renovating their physical spaces for the diverse user groups as they can work collaboratively with digital and print media (Sinclair, 2009). In defining LC, Beagle (2006, p. xviii) mentioned as it happens when all Information Commons (IC) resources supporting the IC are "organized in collaboration with learning initiatives sponsored by other academic units, or aligned with learning outcomes defined through a cooperative process." So, LC is a service of libraries that brings in one location of other services, facilities and learning resources to support users' learning (Donkai, Toshimori & Mizoue, 2011).

Academic libraries are now trying to reinvent themselves and they are initiating LC to meet the changing needs of the users (Sinclair, 2009). As IC reflects on transmission of knowledge primarily to users, whereas LC reveals a change in learning theory by emphasizing on creation of knowledge by the collaboration and interaction of commons staffs and users and users' self-direction in learning (Bailey & Tierney, 2008). It is a unique service from the library where librarians, commons staff, technical staff, student tutoring staff collaborate and interact with users (for learning by teaching) for their assignments, research, writing, technical support, program on information literacy, faculty development, curricula development and so on. LC creates an environment of combined understanding of user needs together with library commons staff and users for their learning. For the successful implementation of LC in libraries, librarians and commons staff needs to have sufficient knowledge and skills of 'Blended Librarianship' which combines traditional skill set of librarianship with information technology skills, and educational designer's ability to apply them in teaching and learning (Shank, 2006).

2.4.1 The Commons Model

Donald Robert Beagle (2006) in his *The Information Commons Handbook* has provided a model for Information Commons/Learning Commons which he mentioned as the 'Commons Model' for library. This conceptual model has combined three interrelated and interdependent levels: the Physical Commons, the Virtual Commons and the Cultural Commons (Beagle, 2006; Beagle, 2008). The first one Physical Commons consists of the

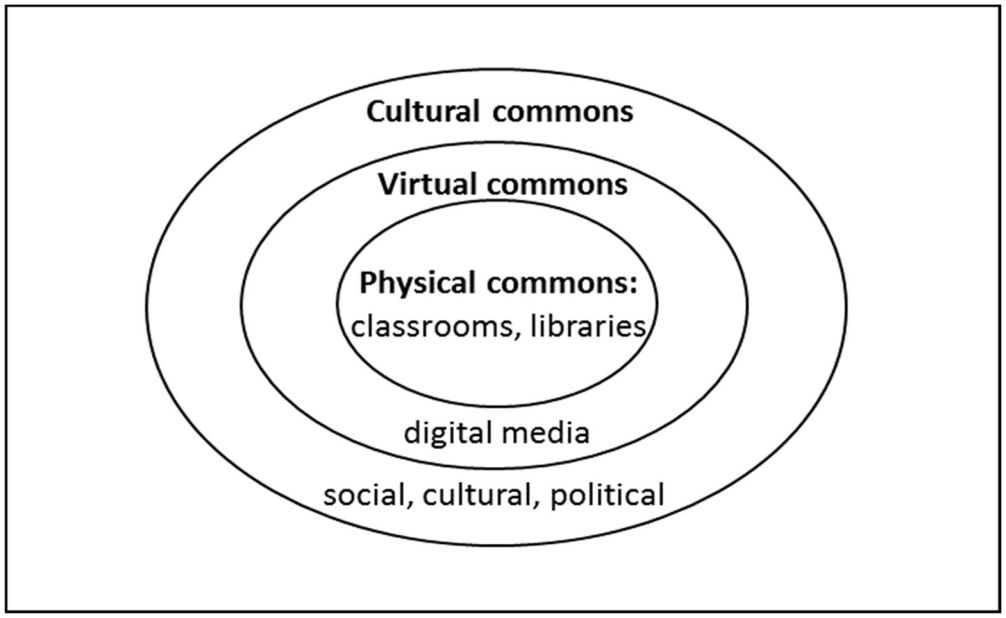

Figure 2.1 Three-Domain Diagram of the Commons (adapted from Beagle, 2012, p. 521)

computer hardware, furnishings, designated spaces, and traditional library collections (Beagle, 2006, p. 8). The second level, the Virtual Commons, contains the Web environments (portals, websites, etc.), digital library collections, e-learning tools and online tools (search engines, productivity software, etc.) of the library. The third level, the Cultural Commons, is made up of social resources like workshops, tutoring programs, research collaborations, coaching, and so on, that takes place as a result of the group environment created through the Commons (Beagle, 2006, p. 8). Social, cultural and political envelope of cultural commons supports and extends the physical commons and virtual commons and these are the enabler for learning in LC (Beagle, 2006, p. 5). These three levels of commons model forms a 'continuum of service' (Beagle, 2012) and co-create the value of learning among the library users.

2.4.2 Components of Information/Learning Commons

LC arranges various components to create a collaborative learning environment in the library spaces. To some extent, facilities and components of LC in each academic library are different but they hold the same objectives. In their studies Lippincott (2005; 2006) and McMuller (2007; 2008) has identified some components of information/learning commons that are more or less available in academic libraries. Most common components

of LC are Computer Workstation Clusters, Service Desk, Collaborative Learning Spaces, Presentation Support Centers, Faculty Development Centers, Electronic Classrooms, Writing Centers and Academic Support Units and Community Spaces.

2.4.2.1 Computer Workstation Clusters

These are the public access computers designed for the work areas of LC as the students can use them with comfort (Bailey, 2006). Configuration of those computers is determined with productivity software for helping the students in different learning tasks.

2.4.2.2 Service Desk

For providing support to students in their versatile learning activities libraries arrange integrated services from a single service desk or they co-locate desks jointly with commons staff and IT staffs in LC (Lippincott, 2006, p. 7.3; McMullen, 2008).

2.4.2.3 Collaborative Learning Spaces

The heart of LC is 'collaborative learning' and collaborative learning spaces create the opportunity for knowledge creation in learning. Libraries provide group study rooms, Internet Cafés and Cafés equipped with computer workstations, large monitor and projectors including specially designed furniture for collaboration. Students gather here to learn in groups or teams including the commons staff.

2.4.2.4 Presentation Support Centers

Most of the LC is equipped with high technology centers to support the students in multimedia presentation works. Presentation support centers are equipped with extended configuration computers, image scanners, special purpose software for presentation and digital display devices where students get support from technology staff (McMullen, 2008).

2.4.2.5 Faculty Development Centers

This center is also known as a teaching learning center which is frequently supported by the Instructional Technology department of the university (McMullen, 2008). Faculty get support for instructional design, technology supported teaching design, use of digital resources, assistance for course management software and presentation software (Lippincott, 2006, p. 7.4; McMullen, 2008).

2.4.2.6 Electronic Classrooms

Most of the LC has incorporated electronic classrooms equipped with computer workstations, multimedia projectors, scanners, interactive boards, wide screens, and communication devices for video conferencing (Lippincott, 2006). These classrooms are used for various learning functionalities for students, faculty and training for library staff (Lippincott, 2006; McMullen, 2008).

2.4.2.7 Writing Centers and Academic Support Units

For enhancing academic and research writing skills of the users most of the LC has introduced 'Writing Centre/Lab' with the partnership of university's writing center or other academic support units like Academic Advisement, Student Success Center, Tutoring and Service Learning, Career Center (Lippincott, 2006; McMullen, 2008).

2.4.2.8 Community Spaces

LC offers academic and social spaces outside the classroom for student's formal and informal learning which also encourages the creation of a campus community (Lippincott, 2006). Community spaces for meetings, seminars, arts display, film show, and cultural events can fuel exchange of ideas among the student community (Lippincott, 2006; McMullen, 2008). The community spaces of LC are treated as '*Ba*', the shared context where knowledge is shared, utilized and created in action, interaction and sharing with others (Siddike, Umemoto & Kohda, 2014; Somerville & Harlan, 2008, p. 11).

2.5 Learning at Learning Commons

Libraries and learning have always been inseparably linked from the very beginning (Bennett, 2009). Learning in LC is a collaborative and interactive process including learners, librarians, instructor, tutoring staff, instructional designers, information technologists, learning contents, and peer learners. Learners, researchers, and information professionals can pursue a variety of learning and research curricula and activities in learning commons, which provide physical, technological, social, and intellectual environments (Bailey, 2006). LC fosters a collaborative atmosphere in which library commons staff and users collaborate to better understand user learning and research requirements.

2.6 Constructivist Learning Theory

Constructivism isn't a specific pedagogy. We need to keep in our mind that constructivism is a term that integrates numerous theories into one to better explain how students learn and acquire and organize their knowledge for use in learning. It refers to both learning theory and epistemology, which includes both the study of how individuals learn and the nature of knowledge (Hein, 1991). Jean Piaget (1896–1980) is largely credited with formalizing constructivism theory. Piaget (1973) and von Glaserfeld (1984) have viewed learning as a process in which students actively generate meaning (knowledge). According to Piaget (1977) learning takes place in the active process of creation of meaning and not it happens passively by learners. He argues that a condition of disequilibrium or imbalance is formed when we, as learners, face an event or a state that challenges our way of thinking (Amineh & Asl, 2015). To re-establish equilibrium or balance, we must change our way of thinking. We make sense of new information for this purpose by linking it with what we already know, or by striving to incorporate it into our previous knowledge (Amineh & Asl, 2015). As mentioned by Oldfather & Dahl (1994) that Vygotskian (1978) views learning emphasize mutuality between the individual person and the social context, as well as the role of the more knowledgeable other in learning facilitation. There is no other form of learning but constructing meaning (Hein, 1991). Constructivism has been defined as, ``an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner`` (Elliott, et al., 2000, p. 256). Learners actively participate in the learning process, and they share their previous experience to create something meaningful (knowledge).

Constructivist theory holds that learners construct knowledge by understanding new information building on their current understanding and expertise (Brown, 2005). It emphasizes development of learners' ability in solving their real life problems (Huang, 2002). Collaboration, personal autonomy, generativity, reflectivity, active engagement, personal relevance, and pluralism are the values that form its instructional principles (Lebow, 1993; cited in Savery & Duffy, 1995). Students interact within the ring, forming

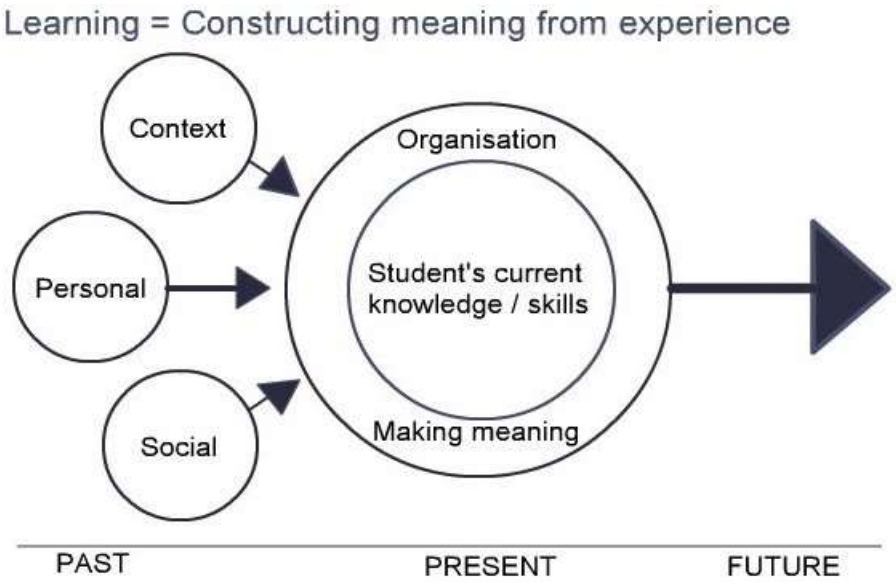

Figure 2.2 Constructivism Learning Process (based on The Teachers Toolbox, 2020, p. 1)

a group that interacts with the educator, who functions as a mediator, bringing students closer to the situation and to achieve this, the educator must use social interactions to generate meaningful zones of proximal development and cognitive bridges (Brandon & All, 2010). Whether learners are using their experiences to understand a lecture or following the directions of instructors to solve problems, the constructivism theory implies that learners construct knowledge from their experience in both circumstances (Wikipedia, 2020). It is, however, obvious that learners share their experiences in active interaction and participate in the learning process to construct knowledge within this social interaction in the context of solving problems.

2.6.1 Constructivist Learning Principles

Piaget (1973), von Glaserfeld (1984), Glaserfeld (1984) and Huang, (2002) has suggested that learners may learn actively and create new knowledge based on what they already knew. The constructivist theory implies that learning is best served when it is contextual, active and social (Brown, 2006; Hein, 1991; Oldfather & Dahl, 1994). Hein (1991) has summarized those ideas in the principles of constructivist learning theory which is concisely written below.

2.6.1.1 Active process

Learning is an active process in which the learner generates meaning from sensory input (Hein, 1991). Learning, according to Piaget (1977), occurs through the active process of meaning construction rather than passively by learners. It denotes that learners are not the passive receiver of knowledge, rather they engage in an active process of creating meaning (knowledge). They collect new information during the active collaboration of learning and mixed information with the old one and transform existing knowledge into knowledge. Throughout learning they share and acquire the collected knowledge and create new knowledge.

2.6.1.2 Social activity

Learning is a social activity, our learning is inextricably linked to our interactions with other people, including our teachers, friends, family, and casual acquaintances, such as those in line ahead of us or next to us at the exhibit (Hein, 1991). The relevance of the socio-cultural context in which learning occurs, as well as how the setting influences what is learned, is emphasized by Vygotskian theory (Vygotsky, 1978). Learners engage in the social production of knowledge in an effective learning process. It is clear that knowledge is created in the active social learning of the learners.

2.6.1.3 Context of Learning

Learning is contextual, we don't learn solitary facts and ideas in some ethereal realm of the mind distinct from the rest of our life; we learn them in context (Hein, 1991). Learners need a proper context for pursuing their learning actively. If the context is too far off from their expected vista, individuals may stop their hunt for meaning, bored or puzzled, or both (Smith, 1975). The contextual view considers two key components of learning: the interactive character of learning and the structural features of learning that are based on a social framework (Caffarella & Merriam, 1999). As a whole, learning is an active process where learners socially engage to construct meaning (knowledge) in a certain context in their mind.

The principles of constructivist learning theory has explained that learning occurs in the active engagement of learners and knowledge is created socially within the context. Now it would be clear to the library practitioners that LC is a place which supports the

constructivist theory by providing an out of class learning environment as a learning resource for the learners to solve learning problems.

2.6.2 Constructivist Learning and LC

Constructivist theories are now prevalent in most of the non-formal education sector (Wikipedia, 2020). LC`s implementation of new knowledge media and the functional integration of new campus IT infrastructure, as well as the creation of group learning spaces would connect the library with the increased interest among faculty in constructivist learning theory (team-based, group-process, resource-based, inquiry-driven, etc.) (Beagle, 2012). LC is an informal learning environment in which all resources, services, and spaces are brought together in a service continuum to connect learners. Here learners gather to work through their course work concerns with peers, faculty, and LC tutoring professionals. It is a warm and inviting out-of-class area where students can collaborate to create meaning. In a way, LC is a place where learners can actively participate in learning through social interaction in order to co-create knowledge while addressing issues in context.

2.7 Problem-Based Learning (PBL)

Constructivist theories have influenced a variety of educational practices, including Problem-Based Learning (PBL) and in general, include various characteristics that are thought to facilitate successful learning (Loyens & Gijbels, 2008). PBL is a tutorial process and was introduced in the Medical Faculty at McMaster University in Canada (Barrows & Tamblyn, 1980). The fundamental approach of PBL is problem solving based learning. It's a learner-centered instructional (and curricular) strategy that encourages students to conduct research, integrate theory and practice, and use knowledge and skills to come up with a viable solution to a problem (Savery, 2006). It not only helps the

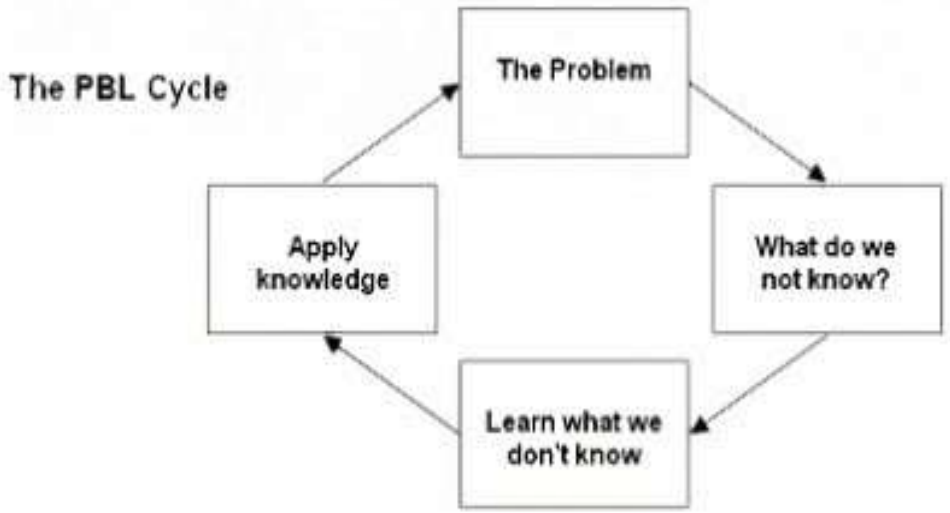

Figure 2.3 Problem-Based Learning (based on UK Centre for Legal Education, 2010, p. 1)

learners engage in learning but also help them to create meaning (knowledge) for solving the learning issues. PBL is an instructional approach in which students learn via the use of an assisted complex problem with no one correct answer. (Hmelo-Silver, 2004). In this approach learning starts with a posed problem which the students try to reach in an answer. It makes them understand how to deal with the given problems and also enhance their skills to work collaboratively and think logically. PBL develops learning skills of students such as how to solve complicated problems, think critically, analyze and evaluate information, collaborate effectively, and communicate efficiently (Duch, Groh & Allen, 2001; English, & Kitsantas, 2013). It uses a simple tool to assist students' problem solving and learning: a structured whiteboard containing lists of facts, thoughts (i.e., hypotheses), learning challenges, and action plans (Hmelo-Silver, 2004).

In the PBL process students take charge towards their own learning and the major role of the teacher is to spark motivation of the students towards problem solving. Students are encouraged to apply what they've learned and to be reflective and self-directed learners (Hmelo-Silver, 2004). Students make use of what they already know about the problems they encounter. In the course of learning they create new knowledge and mix it with the old one by sharing and acquiring between them and it continues till checking their hypothesis. Teachers inspire reflection of learners and ensure opportunity for learning by logical thinking, providing scaffolding, feedback, and advice (English & Kitsantas, 2013). In the PBL process students need to take charge of their learning and they start with ill-

structured problems. They keep motivating themselves and pursue research within their self-directed learning.

2.7.1 Characteristics of Problem-Based Learning

In his study Barrows (1996) has mentioned six characteristics of PBL. Some other studies have also identified a few characteristics of this method (Dahlgren and Dahlgren, 2002; De Graaff & Kolmos, 2003; Oliveira, dos Santos, & Garcia, 2013). Savery (2006) has outlined the following characteristics of PBL.

2.7.1.1 *Students must be responsible for their own learning.*

PBL learners are responsible for their own learning to solve the learning issues and it is a learning-centered approach. Learner motivation increases when the learner is responsible for the solution to the problem and the process (Savery, 2006). Here learners feel self-directedness for collecting new information and creating meaningful solutions.

2.7.1.2 *The posed problem must be ill structured and permit investigation.*

In PBL, problem simulations must be unstructured and allow for unfettered investigation (Savery, 2006). The organizing focus and stimulus for learning are problems and it needs to engage learners to combine their understanding (Barrows, 1996).

2.7.1.3 *Learning from a variety of areas or subjects should be blended together.*

Students should be able to acquire, examine, and integrate information from all disciplines that may be relevant to understanding and addressing a specific problem (Barrows, 1996). In this process students need to be self-directed to obtain new information and blend with the previous base to create ideas.

2.7.1.4 *Collaboration is necessary.*

PBL is a method where collaboration among the learners is a must do activity for solving the problems. At one stage of learning they actively engage in groups for creating meaning (knowledge). During a PBL session, the tutor asks questions of any and all members to ensure that knowledge about the group's problem has been shared and acquiesced with the existing one (Savery, 2006).

2.7.1.5 ***Students must apply what they learn during their self-directed learning to the problem through reanalysis and resolution.***

The goal of self-directed research is for individuals to gather information that will help the group make better decisions about the situation (Savery, 2006). Learners of PBL must convey their collected information to the other mates in a way that can perform to solve the problem.

2.7.1.6 ***A final analysis of what has been learnt by working on the problem, as well as a discussion of the concepts and principles learned, is required.***

Learners are often very near to the immediate details of the problem and the proposed solution because PBL is such an engaging, motivating, and immersing kind of experiential learning (Savery, 2006). It is necessary for the PBL learners to review that before the solution of the problem, what was their level of knowledge, what they have learnt and how well they did (Barrows, 1996).

2.7.1.7 ***At the end of each problem and each curricular unit, students should assess themselves and their peers.***

The preceding key trait of reflection on knowledge gains is closely tied to these evaluation activities associated with the PBL process (Savery, 2006). It ensures the self-reflective behavior of the learners.

2.7.1.8 ***Problem-based learning activities must be those that are related in the actual world.***

In the PBL process it is expected that learners should be assigned to solve real life problems, so that the knowledge they gain in problem solving can contribute to their lifelong learning.

2.7.1.9 ***Exams for students must track their progress toward problem-based learning objectives.***

PBL has both knowledge-based and process-based aims, and to ensure that students are benefiting as intended from the PBL approach, they must be examined on both aspects at regular intervals (Savery, 2006). Here they need to self-recognize what they know, and they have learnt in covering the curriculum for solving its problems.

2.7.1.10 *Problem-based learning must be the pedagogical foundation of the curriculum, not part of a didactic curriculum.*

Problem-based learning must be the pedagogical foundation of the curriculum, not only a supplement to it (Savery, 2006).

2.7.2 User-Centered Learning at LC

In todays` student–centered learning implies that students have a choice in what they study and how they study (O'Neill & McMahon, 2005). A student-centered learning strategy encourages students to take more responsibility for their own learning and is a process that significantly relies on professional confidence to 'let go' of standard teaching obligations (McCabe & O'Connor, 2014). Gibbs (1992) has defined student-centered learning as it, "gives students greater autonomy and control over choice of subject matter, learning methods and pace of study" (p. 23). So, in student-centered learning students are much more responsible to take charge of their learning and they can choose what to study, how to study and set the learning goals by themselves.

Libraries are now in a paradigm shift from information resource-centric view to user-centric approach (Scupola & Nicolajsen, 2010). LC is a facilitator for user students to engage them in active learning in an out of classroom environment and helps them to construct knowledge by solving learning problems. As an informal learning space, LC has introduced an emerging learning pedagogy by collaborating multiple support units and tutoring and learning services. User students use LC spaces for pursuing their self-directed learning and work collaboratively with their group mates. They are very much open to choose their own topics and methods by themselves and are responsible for their own learning goals. So the student-centered learning at LC is nothing but user-centered learning (UCL) for libraries. It is a unique learning pedagogy in academia based on self-responsible learning of LC users.

2.7.3 Group Learning (Collaborative Learning) at LC

The LC has inspired librarians and others on campus to consider the role of learning in libraries in a variety of ways (Bennett, 2015). LC is an integrative and dynamic model that contextualizes information and offers collaborative workspaces where group processes can modify knowledge in ways that reflect the large-scale growth of knowledge

in the culture around us will be more beneficial to them (Beagle, 1999). Here students across the places were increasingly forming their own collaborative study groups to engage more deeply and frequently and sometimes quite adventurously with their coursework and assignments (Bennett, 2003). LC offers a more comprehensive set of technology resources, more fully integrated services, and a wide selection of collaborative work spaces with varying types, sizes, and adaptability (Bailey & Tierney, 2008, part 1). The purpose of LC resources and services is to foster collaboration and group activity among the learning mates. Students were increasingly forming their own collaborative study groups to engage more deeply and, in some cases, more adventurously with their schoolwork. Recognizing the value of this type of learning, many professors included experiential and problem-solving materials in their classes and designed tasks to encourage collaboration (Bennett, 2003).

2.7.4 Informal Learning at LC

Learning Commons (LC) is a location where new ways of thinking and acting emerge (Bennett, 2015). It`s main goal is to facilitate student learning by leveraging the convergence of materials, technology, and services in a physical space to link LCs` development with the requirements and aspirations of the `TechieGen` students (Beagle, 2012; Lippincott, 2006). As Bennett (2008) mentions that "the words academic, collaboration, teaching, technology, and media often appear in names, along with or in the place of information and learning." Those elements studies that focus on staff learning, student learning, focal points of service delivery, and job redefinition are of particular importance to an examination of learning paradigms founded in organizational change (Beagle, 2012). LC support for informal learning through face-to-face reference encounters, group study rooms, and social areas (Beatty & White, 2005). This type of opportunity creates the environment for informal learning for students (Lippincott, 2006). In fact, they stimulate learning in a way that we can evaluate (Bennett, 2015).

LC creates group study rooms, cafes, display areas, digital lab, tutor zone and digital resources to facilitate users learning in this area. It offers the opportunity for formal and informal learning in an out of class space to work in groups to solve their course studies problems. Basically, when students are learning at LC they use the three interrelated and interdependent levels: of the Physical Commons, the Virtual Commons, and the Cultural

Commons (Beagle, 2006; Beagle, 2008). They use the services, resources and spaces to engage in collaborative works among the peers in solving the course work learning issues. It is a unique place to pursue informal learning in an out of class environment in academia.

2.7.5 Knowledge Creation and Sharing at LC

A learning commons would be based on the social elements of learning and knowledge, and it would be run by students for a variety of learning goals that change often (Bennett, 2003). It extends the "electronic continuum of knowledge media" to place a greater emphasis on knowledge creation and construction (Bailey & Tierney, 2008). The fundamental activity of a learning commons, unlike an information commons, would be collaborative learning, in which students turn information into knowledge and, occasionally, wisdom (Bennett, 2003). Collaborative learning is based on the Kuhnian concept that knowledge is a consensus; it is something that people create together through discussion (Bruffee, 1999). As cited by Beagle (2012) that Nagata (2008) is working on a project that looks at IC and LC spaces as manifestations of the Japanese notion of the `ba`. According to Nagata (2008), the two Commons should share the role of `Ba' which is crucial in fostering knowledge and learning among the student users during course studies and problem solving. Knowledge is not a preformed, static substance and it is in perpetual flux, where learning entails active participation in the changing processes (Beagle, 1999). Accordingly, LC offers collaborative and interactive learning spaces for students. Learners are creating knowledge during the group process of learning, and they share that knowledge among the group mates for generating new ideas and solving problems. Constructivism is a learning metaphor that compares the process of acquiring knowledge to that of building or construction (Fox, 2001).

2.8 Problem-Based Learning (PBL) Cycle Phases

In the PBL method, students accept responsibility for their own learning, and the teacher primarily functions as a motivator for them to solve problems from the curriculum. Students are assigned to solve real-world problems related to their coursework. They are encouraged to collaborate for their problem solving process and collect new information to mix with the previous information. Students need to be self-directed for sharing and acquisition of knowledge on the way to solve their problems. At the end of the process, they need to assess themselves and their peers to self-recognize what they know and what they have learnt.

PBL method has several interrelated phases that students need to go through to complete their coursework curriculum. Throughout the phases it needs several days to weeks to complete the curriculum. Hmelo-Silver (2004) has delineated PBL phases as a cycle of tutorial process

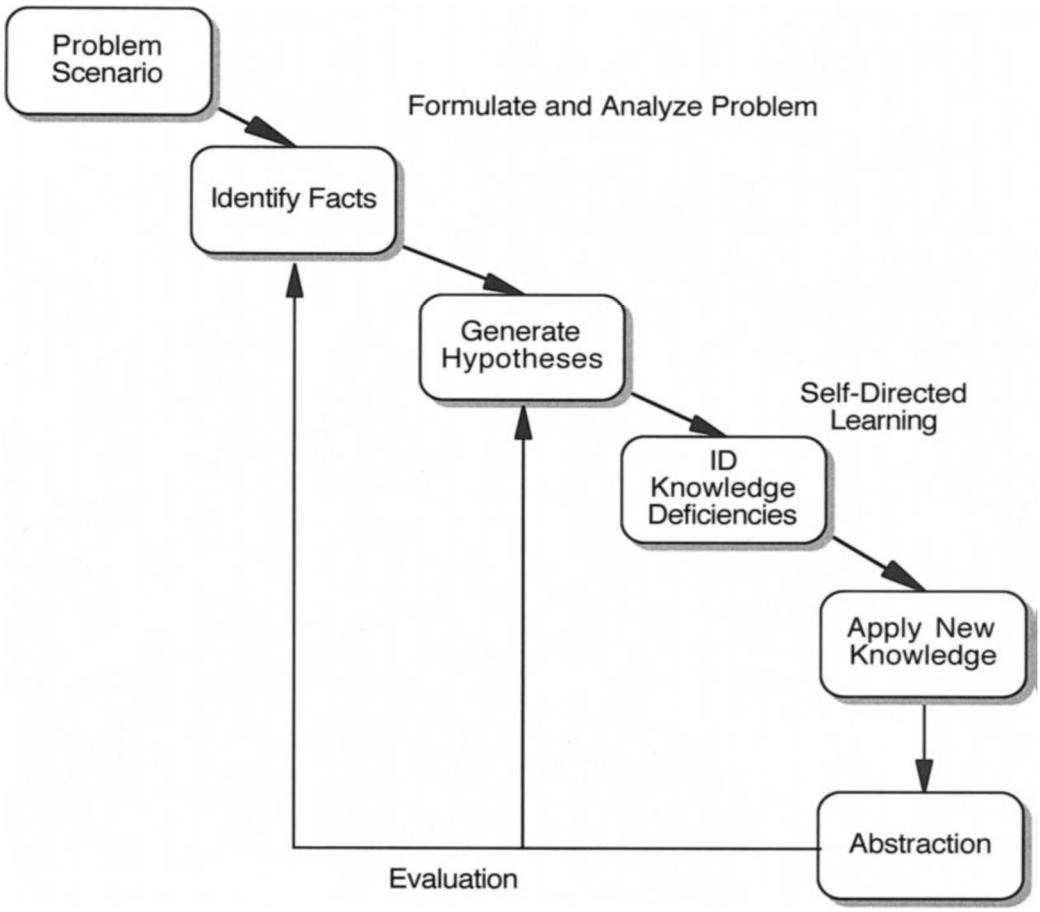

Figure 2.4 The Problem-Based Learning Cycle Phases (Hmelo-Silver, 2004, p. 237)

where students are posed with a problem situation. She states the phases as, ``They formulate and analyze the problem by identifying the relevant facts from the scenario. This fact-identification step helps students represent the problem. As students understand the problem better, they generate hypotheses about possible solutions. An important part of this cycle is identifying knowledge deficiencies relative to the problem. These knowledge deficiencies become what are known as the learning issues that students research during their self-directed learning (SDL). Following SDL, students apply their new knowledge and evaluate their hypotheses in light of what they have learned. At the completion of each problem, students reflect on the abstract knowledge gained`` (Hmelo-Silver, 2004).

In their study Mergendoller, Maxwell and Bellisimo, (2006) has mentioned seven interrelated PBL phases of problem definition, problem framing, knowledge inventory, problem research and resources, problem twist, problem log, problem exit, and problem debriefing are all steps in the problem-solving process. Mohd-Yusof, Helmi, Jamaludin and Harun (2011) have shown that a typical PBL cycle consists of three phases. These are:

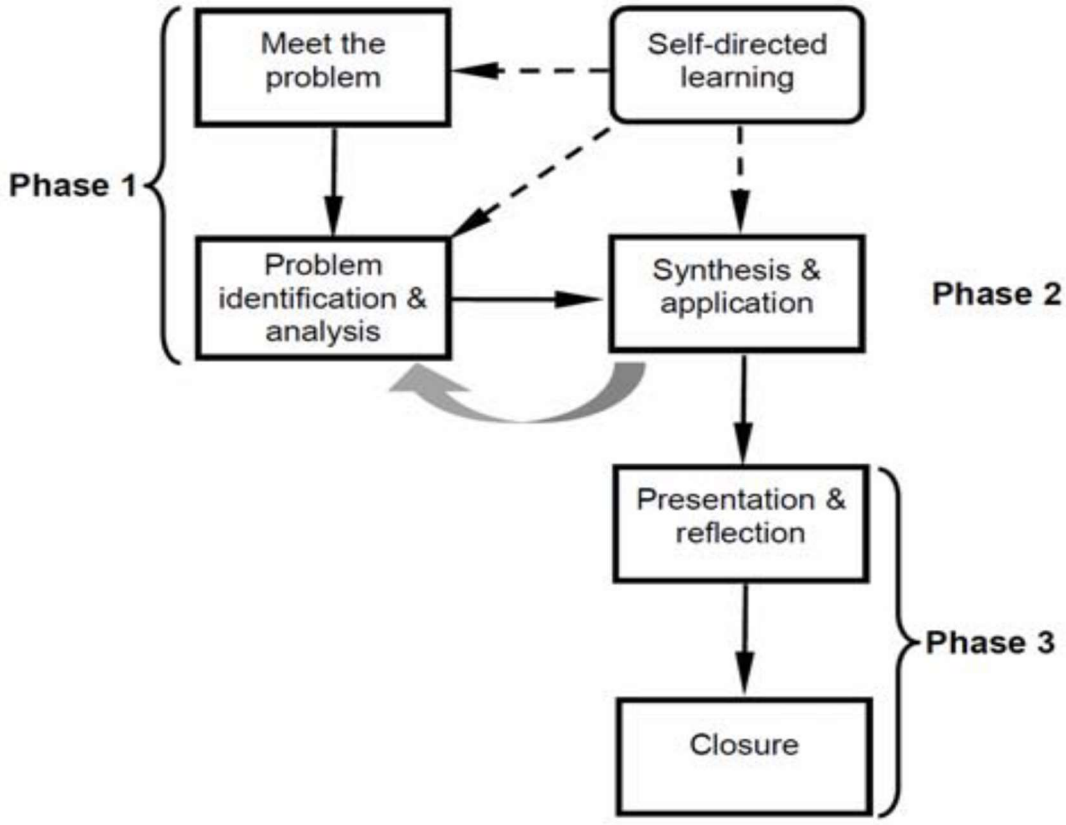

Figure 2.5 Typical PBL Cycle (Mohd-Yusof, Helmi, Jamaludin, & Harun, 2011, p. 13)

Phase 1: problem restatement and identification,

Phase 2: peer teaching, synthesis of information, and solution formulation, and

Phase 3: generalization, closure and reflection.

English and Kitsantas, (2013) has summarized all the learning activities of PBL cycle in three main phases and they have shown a relationship between the activities of Problem-Based Learning (PBL) and Self-Regulated Learning (SRL). Their phases for PBL are: 1) project/problem launch, 2) guided inquiry and product/solution creation, and 3) project/problem conclusion.

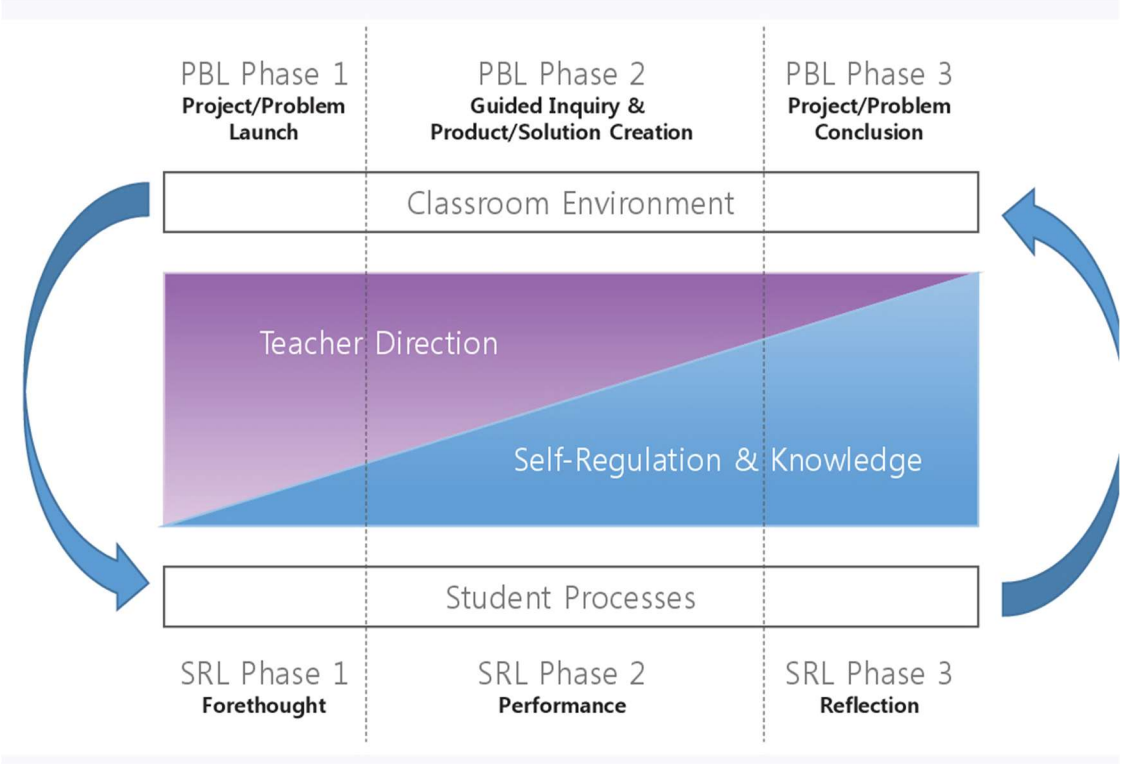

Figure 2.6 Relationships of the phases of PBL and SRL (English & Kitsantas, 2013, p. 133)

2.8.1 PBL Phases in Learning Commons

Nowadays, PBL is gaining interest among the educationists because of its active collaboration and increased motivation of students for learning. All the learning activities of PBL students need not to be done within the classroom in the presence of their teachers. Students are usually allowed to do some activities outside of their classroom and most of the time they go to their library to use LC spaces. Thus, LC provides services and tools to support PBL activities of its user students and the environment of LC is very much suitable for user-centered learning. Based on the above-mentioned literature this study has identified the PBL cycle phases from the perspective of learning commons (LC) users as follows:

2.8.1.1 Phase 1: Problem Identification

The students in the first phase of PBL cycle are presented with real world complex problems which do not have a single answer. In the beginning students learn about the driving question of the problem statement and the learning objectives (Mergendoller,

Maxwell & Bellisimo, 2006). Students would use current knowledge, inquiry, and other learning processes to develop an original response to this topic, rather than looking up the answer in a textbook (English & Kitsantas, 2013).

The problem-solving approach creates a clear picture of the learning issue (English & Kitsantas, 2013; Hmelo-Silver, 2004). To work with learning issues in out of class spaces, students go to the LC to engage in learning. Students use LC to solve challenges related to learning, such as assignments, presentations, projects, and exams. They strive to grasp and describe the problem by various learning activities such as discussion, sharing, feedback, and so on with their group mates.

2.8.1.2 Phase 2: Formulate Inquiry

In the next phase, the students formulate and analyze the problem by identifying the key facts from the complex situation which helps them to represent the problem (Hmelo-Silver, 2004). As cited from Mergendoller, Maxwell and Bellisimo, (2006) by English & Kitsantas (2013) that gathering knowledge, producing meaning, reflecting, and testing discoveries (via evidence checking, experimentation, application of logic and reason, and input from peers and the teacher), and revising as needed are all part of the iterative cycle of PBL activities. Here the students determine what they need to know more to start the inquiry, try to identify the knowledge gap about the problem and they formulate hypotheses for the solution. Students may consult websites, TV and they may go to the library and get books and DVDs (English & Kitsantas, 2013).

Students working in LC use inquiry to try to come up with the questions they need to know in order to solve challenges (English & Kitsantas, 2013; Hmelo-Silver, 2004). They collect information/knowledge from a variety of sources and share it with their peers in order to identify knowledge gaps that may be investigated further. This is the peak time when user students use the LCs` designated learning tools and spaces to collaborate with their peers and take help from the tutoring staff for furthering the inquiry and closing the knowledge gap. In this way the out of class spaces of LC helps them to collaborate and generate hypotheses.

2.8.1.3 Phase 3: Knowledge Sharing and Acquisition

This study has identified knowledge sharing and acquisition as a new phase of the PBL cycle. Identifying knowledge gaps in relation to the problem is an important aspect of this cycle and these gaps are known as the learning issues that students research during their self-directed learning (SDL) of PBL (Hmelo-Silver, 2004). The students create questions based on self-identified knowledge gaps, and they use these questions to steer independent study outside of the classroom, with research assignments distributed among team members (Allen, Donham, & Bernhardt, 2011). In their learning process students collect knowledge and share and acquire among them for creating new knowledge on the way to solve learning issues. In the first phase students try to find the knowledge gap and gradually they collect, share, acquire, create new knowledge, apply, and review what they have learnt at the end of the phases. Thus, the knowledge sharing and acquisition process begins in the first phase of the cycle and ends till the last phase before concluding the learning problems.

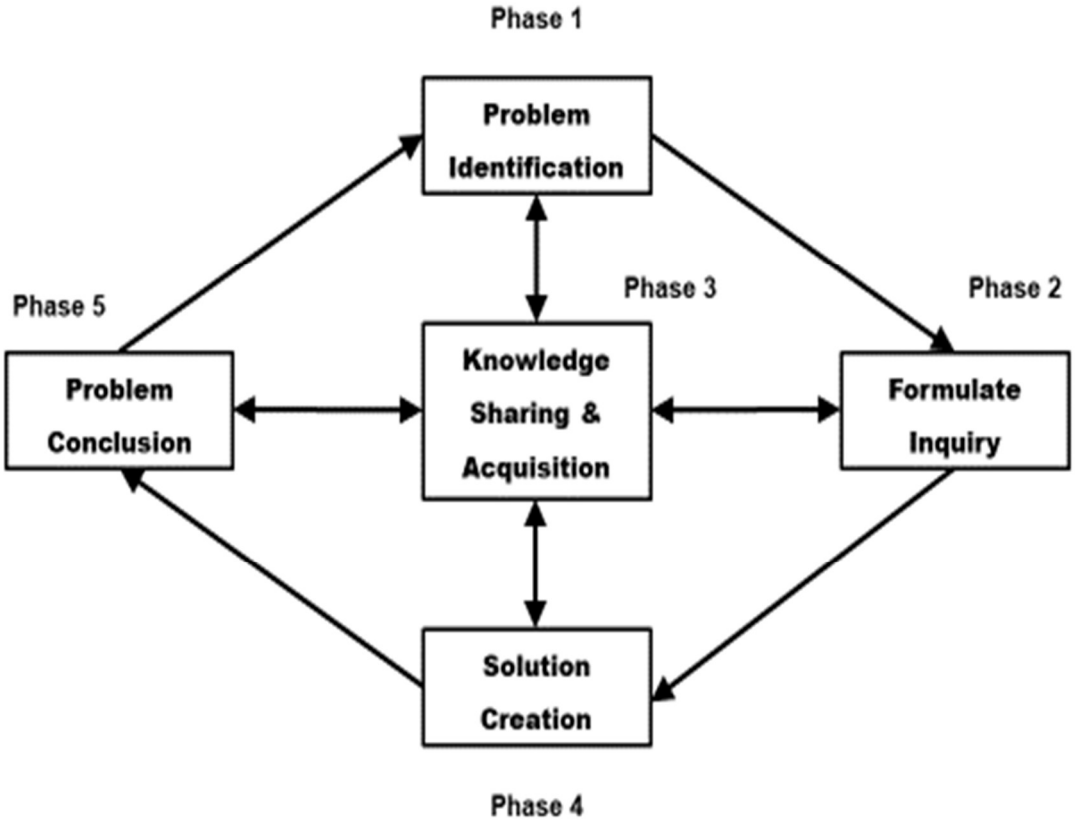

Figure 2.7 Problem-Based Learning Cycle Phases in Learning Commons

User students of LC are no exception to this knowledge sharing and acquisition practice during their PBL process. LC provides spaces and environment for the collaboration of learners to share and acquire knowledge among them. Students use information resources and take help from the LC staff to collect information about their problem topics. LCs` group work opportunity for the learners gives them the chance to identify knowledge gaps and they share and acquire new knowledge for solving the learning problems.

2.8.1.4 Phase 4: Solution Creation

In this phase students build hypotheses about possible solutions as they have a deeper understanding of the problem (Hmelo-Silver, 2004). Students would share their findings with one another, interpret them, come up with new ideas and discoveries, and decide how best to convey their findings (English & Kitsantas, 2013). They try to summarize what they knew in the beginning and what they have learnt within the scaffolding process. Students then use their findings to construct a final product or solution that not only addresses the driving issue but also displays their conceptual grasp and achievement of the learning goal (English & Kitsantas, 2013). It is needed for students to retain and apply new knowledge with the problem situations when they are preparing the solution (Allen, Donham, & Bernhardt, 2011).

In this stage students start thinking about the possible solution of the problem. They strive to make sense of the information gathered by coming up with fresh ideas and looking for the best answer (Allen, Donham, & Bernhardt, 2011; English & Kitsantas, 2013). Students start to practice their tentative solutions in the LCs` designated classrooms, writing lab, digital labs and take help from their teachers as well as LC staff to reach a concrete answer.

2.8.1.5 Phase 5: Problem Conclusion

This is the last phase of the PBL cycle where students present their final solution to the problem. Students consider the project goals and expectations in relation to the overall learning outcomes and process outcomes (Mergendoller, Maxwell & Bellisimo, 2006). They continue to designate new areas of essential learning as they progress through the stages of a difficult problem in search of a solution (Allen, Donham, & Bernhardt, 2011). During this phase students present their idea or solution, as well as how they arrived at

their conclusions (English & Kitsantas, 2013). They summarize their findings and present the final solution to meet the learning goals of their coursework.

In LC, for presenting the final conclusion of the problem, students prepare the final presentation in collaboration with their group mates and also take help from its tutoring staff. Through collaboration and group discussion in the LC`s designated space they reach the problem conclusion. Student groups generally move through the phases in the order indicated but may return to a previous phase or linger in a phase as they consider a particularly difficult part of the problem (Mergendoller, et.al, 2006). In order to be successful in the PBL process it needs the students to be more responsible for their own learning. This includes self-regulatory activities such as maintaining motivation, setting goals, tracking progress, and reflecting on oneself. (English & Kitsantas, 2013).

2.9 Problem-Based Learning at Learning Commons

PBL learners tackle contextual real-world problems through active participation in problem-solving activities, as well as considerable networking, communication, and collaboration (Brown, 2005). Students all across the world were increasingly forming their own collaborative study groups in order to engage more deeply and, in some cases, more daringly with their assignments (Bennett, 2003). Hmelo-Silver (2004) has identified two key issues of PBL process which are very pertinent with the LC services. She (Hmelo-Silver, 2004) states that, ``first, all the approaches emphasize that learners are actively constructing knowledge in collaborative groups. Second, the roles of the student and teacher are transformed. The teacher is no longer considered the main repository of knowledge; she is the facilitator of collaborative learning ``.

The heart of LC is to provide collaborative spaces for actively engaging the learners in learning and research. Learning in LC is a collaborative and interactive process including students, tutors, instructors, information technologists, learning materials, and peers (Alam, Yoshida & Kohda, 2016). Moreover, during collaboration learning students are creating new knowledge and sharing and acquisitioning knowledge among them in the problem-solving process. Thus, the students themselves are playing the knowledge transformer role in out of class space which has been introduced by LC. From the above discussion it is already evident that LC has created the environment for pursuing PBL activities for its users.

2.9.1 Theoretical Lens: PBL supported User-Centered Learning at LC

LC and learning are inseparable, and it is a designated space in the library for user students to solve their learning issues. It is a new model of service delivery system in the academic libraries which has introduced a `continuum of services` from a single location. Learning at LC is completely user-centered as today's student–centered learning implies that students have a choice in what they study and how they study (O'Neill & McMahon, 2005). In user-centered learning at LC students are responsible for their own learning and they determine the course work learning problems to reach in the conclusion.

As an out of class space LC support for informal learning through face-to-face reference encounters, group study rooms, and social areas (Beatty & White, 2005). LC group learning spaces have connected the library with the increased interest among faculty in problem-based learning (PBL) of constructivist learning theory (Beagle, 2012). It is PBL that supports LC users by confirming out of class activity for identifying, formulating, searching and sharing learning problems (Khasawneh, 2013). The fundamental approach of PBL is problem solving based learning. It's a learner-centered instructional (and curricular) strategy that encourages students to conduct research, integrate theory and practice, and use knowledge and skills to come up with a viable solution to a problem (Savery, 2006). In this approach learning starts with a posed problem which the students try to reach in an answer. It makes them understand how to deal with the given problems and also enhance their skills to work collaboratively and think logically. Students make use of what they already know about the problems they encounter. In course of learning they create new knowledge and mix it with the old one by sharing and acquiring between them and it continues till checking their hypothesis. In this way they follow the PBL cycle phases of problem identification, formulate inquiry, solution creation and problem conclusion and reach in the solution of the problems (English and Kitsantas, 2013; Hmelo-Silver, 2004; Mergendoller, Maxwell and Bellisimo, 2006).

LC learners are creating knowledge during the group process of learning, and they share knowledge among the group mates for generating new ideas and solving problems. They play a knowledge transformer role among the group mates in the absence of their course teacher. In LC collaborative learning, users actively construct knowledge by acquisitioning knowledge to their early knowledge base as they interpret new information

that they have already collected (Loyens & Gijbels, 2008). That is knowledge sharing and acquisition in the PBL process at LC helps the user students to reach the solution and complete the learning. Therefore, taking the transformer role of users for knowledge sharing and acquisition into consideration the study has extended the PBL cycle phase for LC.

In research Nitecki and Simpson (2016) has studied the LC as informal learning environments and the relationship between space and learning. It also emphasizes how space facilitates learning. The findings of the study have assisted in specifying designs for improved library spaces, advocating for the value the library environment provides educational experiences, evaluating return on investment in renovation and construction, and contributing research to understanding the relationships between learning and space. Alam, Yoshida and Kohda (2016) has determined a value co-creation framework to explore the co-created learning value at LC. They found that diverse actors, such as librarians, faculty members, commons staff, writing tutors and instruction designers, students, and community members, engage and integrate resources to co-create value at LC. To determine and address the different requirements of users, librarians collaborate, communicate, and dialogue with them. According to their findings, knowledge creation, learning skills enhancement, collaborative learning, generating knowledge products, and collaborative co-design are the co-created learning values at LC. Hunter and Cox (2014) have found that students are using information commons (IC) as informal learning space for their learning. According to their findings, students reported that the surrounding environment had a significant impact on their choice of study place, and that technical equipment was only used rarely. Students modified their study habits to meet their preferred learning environments. In another study, Kim (2016) has tried to understand the meanings and the dimensions of a library as a place of study. This study's findings give empirical evidence of users' perceptions of libraries as places, thereby advancing our understanding of users and techniques for effective library space design. Moreover, studies have identified the factors affecting library space assessment, and relationship of space to an academic library's purpose and ambitions (Nitecki, 2011). She mentioned that as reader-centered, book-centered, and learning-centered, it suggests the nature of essential parts of an assessment connected with different library paradigms. In sections titled "space for accumulation, space for service, and space for learning," these three

viewpoints on the library's purpose are briefly explained, along with corresponding assessment perspectives. In their study, Harrop and Turpin (2013) has tried to judge the successful informal learning space design within and outside of the library from the learning theory, place making, and architecture perspectives. They investigated students' attitudes, actions, and preferences regarding informal studying environments in higher education, both inside and outside of the academic library. The learning spaces study adds to the conversation on informal learning spaces design by generating a typology of nine learning space preferences. The few studies on LC and learning theory have focused on user learning. In his study Brown (2005) suggests that LC can adopt constructivist learning theory where learners develop knowledge by understanding new information while building on their existing knowledge and skills. In a study Beagle (2012) has identified that LC group learning spaces have connected the library with the increased interest among faculty in problem-based learning (PBL) of constructivist learning theory. Finally, in his study Khasawneh (2013) has found that it is a problem-based learning (PBL) method that supports LC users by confirming out of class activity for identifying, formulating, searching and solving learning problems. Learning commons support user learning in out of class spaces for solving their learning problems. It is apparent that learning methods like PBL support LC learning and enhance user learning for solving their course work learning problems. But due to lack of empirical evidence in the literature, this research took the lens of PBL methods that support LC user self-responsible, group learning and informal learning in out of class space and solving their coursework learning problems and created a `Continuum of Learning` in LC.

2.10 Summary of Literature Review

By reviewing previously published books and papers, the study has focused on the state and advancement of current literature on learning commons, problem-based learning, knowledge sharing, and user-centered learning at learning commons. All of these studies demonstrated how LC, knowledge sharing and acquisition, and problem-based learning are intertwined, and what LC must do if they want to provide user-centered PBL process based creative services for their students. The review has evidenced that the current Techie Gen (Techie Generation) students are demanding out of class collaborative learning spaces to work with groups. Learning commons has taken the opportunity in

academia, and they have initiated technology based collaborative spaces. In doing so they need to go beyond that and understand how users are using LC three interrelated and interdependent levels: the physical commons, the virtual commons and the cultural commons for learning (Beagle, 2006; Beagle, 2008).

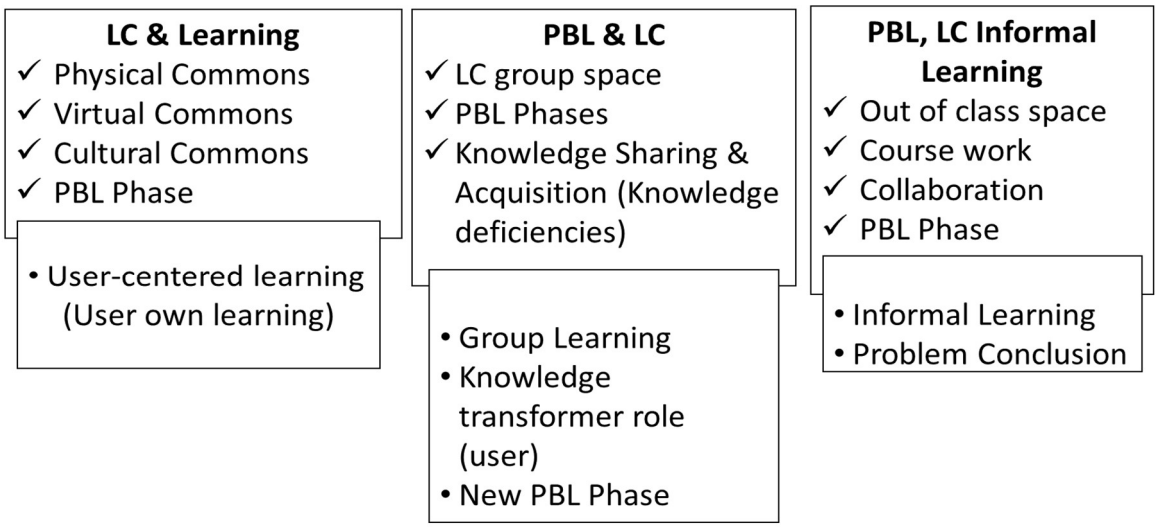

Figure 2.8 Summary of Literature Review

There is a widespread agreement that, in the initial stage PBL learners try to find their knowledge gaps and later they create new knowledge. In the absence of their teachers in LC they play a knowledge transformer role through peer learning and teaching and for solving the learning issues when they share and acquire that knowledge among them. Here LC needs to increase the mediating facility for knowledge sharing and acquisition to the self-responsible learners and patronize user-centered informal learning and research. Moreover, users of LC are PBL learners, and they evolve within its cycle phases for concluding their learning problems. In general, PBL phases have taken into granted that students are working in classes under the supervision of teachers, and they are creating knowledge for solving the issues. In LC the picture is much different from the general PBL process and users are responsible for their own learning and knowledge sharing and acquisition. LC needs to offer the extended PBL phases to see the students' problem identification to problem conclusion phases including knowledge sharing and acquisition in an out of class environment. Learning commons has been regarded as a new service dominant space in the academic libraries. Reviews have identified the gap that it needs to check the LC use for leaning against the PBL phases of users. This study

has to shed light on LC services and take it out from its embryonic stage against the user centered PBL learning.

This research has focused on user learning at LC of academic libraries. There was no evidence that any research has tried to check user learning and learning methods in out of class spaces. In the literature review of this study, it has been found that earlier research has tried to focus on how LC space facilitate learning and tried to judge the successful informal learning space design within and outside of library from the learning theory, place making, and architecture perspectives (Harrop & Turpin, 2013; Khasawneh, 2013; Nitecki & Simpson, 2016; Nitecki, 2011). It has motivated the researchers of this study to take the lens of user learning at LC and found that user learning at LC is supported by problem-based learning (PBL) method.

Chapter 3: Research Methodology

3.1 Introduction

This chapter discusses and justify the methodological approach and methods used in this examination of the user-centered learning at learning commons. The research methodology should be developed in accordance with the research goal and questions of the study (Onwuegbuzie, Teddlie & Tashakkori, 2003). Leedy and Ormrod (2001) define research methodology as the comprehensive steps taken by a researcher before beginning a research project (p. 14). The methodologies employed for quantitative aspects of the study are covered to address the research question driving this study, as well as the main parts of data analysis. The chapter goes through the research design in detail, with the goal of clarifying the data collection, analysis, and interpretation employed in this study. For conducting the survey constructs were determined from the literature review upon which data collection instrument was developed.

3.2 Quantitative Approach

Quantitative research, qualitative research, and mixed method research are the three broad types of research techniques that are often employed in the social sciences as well as research in Library and Information Science (Neuman, 2007; Williamson, 2013). The literature supports the use of quantitative tools in interpretative research like the current study (Glesne & Peshkin, 1992). Quantitative research uses measurable data, as well as statistical analysis, to answer the research questions "what" and "how many" regarding the phenomenon under investigation (Babbie, 2011). Checking the variables from the literature and the relevant elements of the study all required access to a large research population which is possible in quantitative tools. Quantitative research entails gathering data in order to quantify information and apply it to statistical analysis in order to support or refute competing knowledge assertions (Williams, 2011). Apuke (2017) explains quantitative research methods as the process of acquiring data in numerical form and evaluating it using mathematical approaches, particularly statistics, to understand a problem or phenomenon. Therefore, the present study has adopted the quantitative

research approach in order to get insights from a large population and generate statistical, quantitative data.

3.3 Survey Design

The main objective of the research was to empirically confirm the problem-based learning (PBL) supported user informal learning at learning commons (LC). Survey research is a research design that involves surveying a subset or the total population to acquire information on the population's characters, attitudes, beliefs, and behaviors. Survey research is defined as "the collection of information from a sample of individuals through their responses to questions" (Check & Schutt, 2012). This sort of research provides for a wide range of ways for recruiting participants, collecting data, and using various instrumentation techniques (Ponto, 2015). Survey research supports quantitative research approach and use of questionnaire instruments with numerical scale (i.e., Likert Scale) for getting an overall perception of the population. As the quantitative approach is a more scientific and reliable one to dig into the problem, a structured questionnaire was needed to develop (Eyisi, 2016). Therefore, the study adopted the survey research design and conducted an online survey in the learning commons of university libraries of Japan. The study conducted the survey in the university libraries of Japan Advanced Institute of Science and Technology (JAIST), Kanazawa University and Nagoya University. A total of 105 respondents participated in the survey and among them 53 students are from Kanazawa University, 45 students are from JAIST, 2 students from Nagoya University and 5 intern, special and certificate students are from outside of Japan. JAIST and Kanazawa University respondents formed 93.1% of the total responses in the survey. The researchers also tried to include two other renowned university libraries in the survey from outside of Ishikawa Prefecture and contacted them through email. But one of them directly regretted conducting the survey in their library and the other one was taking a very long time to complete their official procedures for the permission. Owing to the time limitations of the research and to complete the survey in due time, we failed to conduct the survey in the later one. As a result, the study completed the online survey in the above-mentioned three universities of Japan. The research goal would be met by using a variety of statistical analysis approaches to the acquired respondent survey dataset, as explained below.

This study took the lens of learning at LC to check whether PBL method supports the user learning. Apart from that, as the researcher is not efficient in Japanese language, it is very common to make mistakes in communication with others in interaction. So, the survey only included the users, but not the other stakeholders of LC like librarians, support staff and other students.

3.4 Online Survey Questionnaire

Three main types of survey research methods are found in the literature including the online/email, phone and face-to-face. Depending on the survey method type and according to its time, either questionnaire or interview survey instruments are used to gather the responses from the respondents. For this study, we have taken the opportunity to conduct the online survey as it is preferred by the participant. Due to the cost-effective process, ease of completion for users compared to paper-based surveys, and flexibility of follow-up with

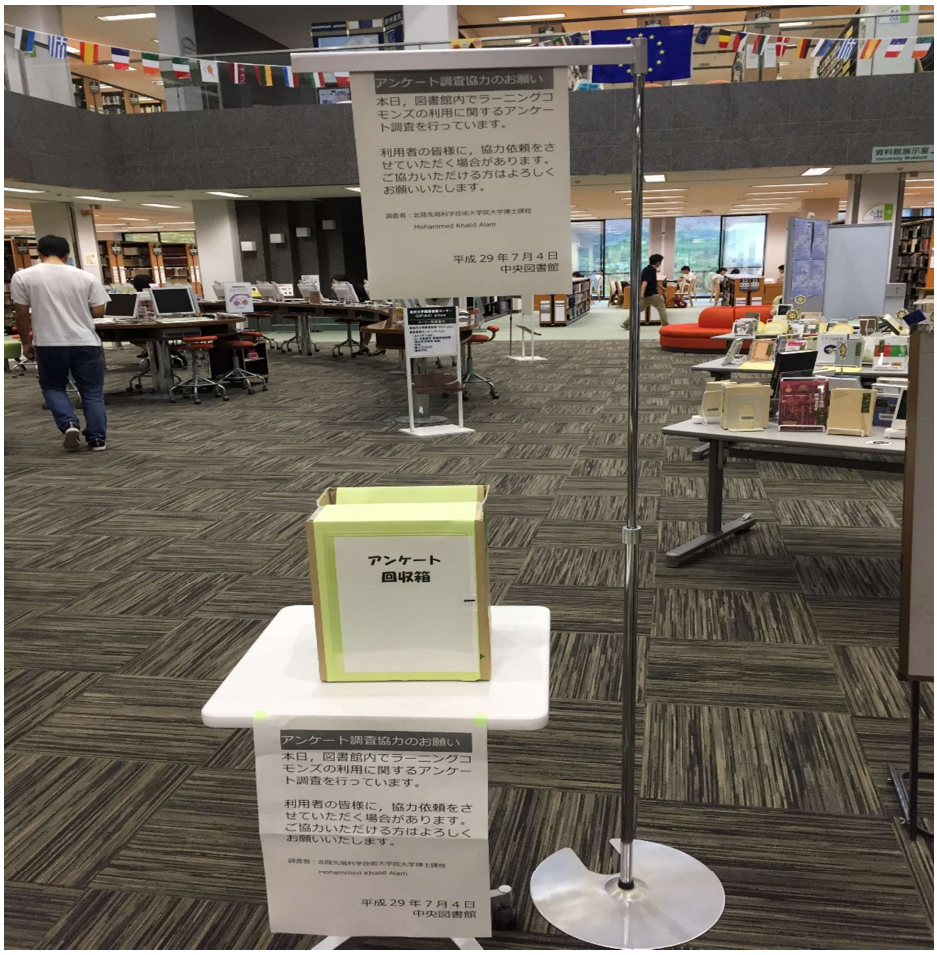

Figure 3.1 Kanazawa University Central Library circulated posters and drop box

relatively inconspicuous reminders, online surveys have the potential for better response rates (Perkins, 2011). A well-designed questionnaire is a crucial component of a successful and well-justified quantitative study (Creswell, 2003). Therefore, in order to perform the online survey, a questionnaire was developed that was deemed to be the greatest fit for the participant. The study used an online questionnaire and was emailed to the student mailing list of JAIST. The Kanazawa University Library authority circulated posters and drop boxes in the Central Library entrance attaching the printed copy of the online questionnaire and some respondents of the Nagoya University were in personal email contact of the researchers. Because of the participants' ease of access, Google Forms was employed as an online survey collecting tool (Majid, 2014; Yip, Lo, Ho & Chiu, 2021) to reach a larger audience. It has identified six constructs and the survey instrument used was developed from the relevant literature review. The questionnaire consisted of 26 questions (item) and a seven-point Likert scale was used ranging from 1= strongly disagree to 7= strongly agree. Google Forms allows you to automatically record replies and export them to an MS-Excel spreadsheet. The questionnaire contained a 'Definition of Key Terms' section to help participants understand their unfamiliar terms.

3.5 Study Area

The study was conducted at Japan Advanced Institute of Science and Technology (JAIST), Kanazawa University and Nagoya University. They are the public universities in Japan. The first two universities are in Ishikawa Prefecture and the later one is in Aichi Prefecture of Japan. These three university libraries have established learning commons for their user students and serve with a good reputation to the community.

3.6 Population and Sample

For each empirical investigation, sample selection is crucial, and enough diversity should be ensured so that acceptable results can be produced from statistical analyses (Alolah, Stewart, Panuwatwanich & Mohamed, 2014). Rather than statistical requirements, sample selection needs to be based on a theoretical perspective (Yin, 2009). The population of this study was the users of learning commons (LC) at Japan Advanced Institute of Science and Technology (JAIST) Library, Kanazawa University Central Library and Nagoya University Library. In search of deep insight about learning at LC the study used a purposive sample by a confined survey participant to LC users. The

sample included the bachelor, master, doctoral, certificate, special and visiting students of those three universities. For widening the global view of the study, certificate, special and visiting students were included who were studying in the mentioned three Japanese universities. Which has brought the opportunity to get varied responses from the

Table 3.1 Population and sample of the study

Academic Institution	Country	Respondent
Central European University	Kosovo	1
JAIST (Japan Advanced Institute of Science and Technology)	Japan	45
Kanazawa University	Japan	53
Mount Royal University	Canada	1
Nagoya University	Japan	2
New Platz State University of New York	USA	1
South West University of Science and Technology	China	1
University Toulouse	France	1
Total		N=105

university students of the USA, Canada, France, Kosovo and China. A total of 105 respondents participated in the survey and among them 53 students are from Kanazawa University, 45 students are from JAIST which formed 93.1% of the total responses in the survey. Due to the limitation in Japanese language the researcher failed to include more universities as a sample of the study.

3.7 Data Collection

The study used the quantitative approach to define the problem and conducted an online survey for collecting data. For this purpose, a structured questionnaire was developed and distributed to the respondents since the quantitative technique is more scientific and dependable for digging into the topic (Eyisi, 2016). Data were collected through surveys from JAIST, Kanazawa University and Nagoya University of Japan during the months of June and July 2017. The online questionnaire was emailed to the student of JAIST by using the university student email list. The Kanazawa University Central Library authority circulated posters and drop box in the entrance attaching the printed copy of the online

Table 3.2 Responses of primary data collection

Institutions	Responses	Percent	Method to reach questioner
JAIST	45	42.9	Student email list
Kanazawa University	53	50.2	Printed copy of online questionnaire
Nagoya University	2	1.9	Personal email
Other universities	5	5.0	Student email list/ Printed copy of online questionnaire
Total	N=105	100	

questionnaire for the convenience of the respondents. Moreover, some respondents of the Nagoya University were in personal contact with the researchers and the questionnaire was directly emailed to them. Out of 105 respondents, 45 respondents took part from JAIST and 53 respondents are from Kanazawa University. 5 international students also took part in the survey as they were staying in those three universities during that time as intern, special and certificate students.

3.8 Data Analysis

The analysis of the questionnaire data for this study was mostly done with the SPSS™ 25 program and also MS-Excel. It has used the Google Drive platform as a survey collection tool. From the original replies, the online dataset was tallied in MS-Excel and then translated to SPSS. The collected dataset was tabulated in three independent projects (JAIST, KU, and NU) and then compiled into a single Excel file. A total of 105 students from the three universities took part in the survey. The study adopted Partial Least Squares – Structural Equation Modeling (PLS-SEM) method to examine the factors or variables and their interaction with the dependent variable. PLS-SEM is a generally established approach for research with a sufficient amount of data and theoretical understanding (Alolah, Stewart, Panuwatwanich, & Mohamed, 2014; Hair, Risher, Sarstedt & Ringle, 2019). PLS-SEM employed a two-step model validation procedure, first examining and validating the measurement model and then testing the proposed theoretical structure, as stated in this technique (Babin & Attaway, 2000; Gerbing & Anderson, 1992).

3.9 A Brief Acquaintance of the Surveyed University LC

3.9.1 JAIST Learning Commons (J-BEANS)

The Learning Commons of JAIST started its journey in November, 2011 with a nickname J-BEANS. Among several other activities, this space is mainly used for group learning and presentation. It is a gathering area for students, faculty, and staff to study and share intellectual ideas together. The room is bright, barrier-free, and has no blind sheet, allowing people to use it freely. Users can utilize it to gather information and, of course, to connect with other people. A group meeting or an event can be held in the room with prior reservation. Comfortable tables and chairs are there for encouraging group learning activities which can be moved around the room as desired. Also, some other low height desks can be used for Japanese style sitting on the floor.

Figure 3.2 JAIST learning commons J-BEANS

3.9.2 J-BEANS: the Meaning of the Nickname of JAIST LC

The seats and tables in this area are designed like beautiful green peas. With friendly love in the image of beans it has been named as "J-BEANS (Jay Beans)" that are packed up warmly together in harmony in a pod. When a bean germinates, it shoots rapidly towards the sky, forming a pod that is firmly packed with beans. In other terms, the bean might be

viewed as a sign of "unlimited expanse" of possibility. J-BEANS becomes a place where individuals develop their knowledge and thoughts, where everyone germinates and grows ideas, like one bean grows into a hundred or thousand more (beans).

Figure 3.3 Group learning at J-BEANS

Figure 3.4 Japanese style sitting in J-BEANS

3.9.3 Learning at JAIST LC

JAIST students, faculty and course tutors are the main users of its LC. They use this space for course work problem solving during the semesters. As an out of class space, it encourages learners to gather for group learning with their course mates. During the semester students are assigned several learning issues like assignments, presentations, exams, report writing, minor research, etc. from their courses. User students gather here to work with their group mates to solve those learning issues. J-BEANS doesn't assign tutoring staff to help its users in learning. Most of the time course tutors use this space to work with their fellow students for solving the course work learning problems. Course tutors join or bring with their user student groups in LC and help them to solve their learning issues. J-BEANS has sufficient arrangement of projectors, screens, display board, VGA adapter, etc. for the practice and rehearsal with the solution of the learning issues. In this way the learners try to reach the problem conclusion.

Moreover, as a social commons, every month J-BEANS arrange lecture series, logic series, workshops, etc. for the LC users. It brings the opportunity for the users to learn unknown topics to generate new ideas and share their knowledge with others for their brain storming. Users can reserve J-BEANS for any occasion or a group meeting with their peers or local people. J-BEANS is a super hub for the students of JAIST as a common space for informal learning within the campus.

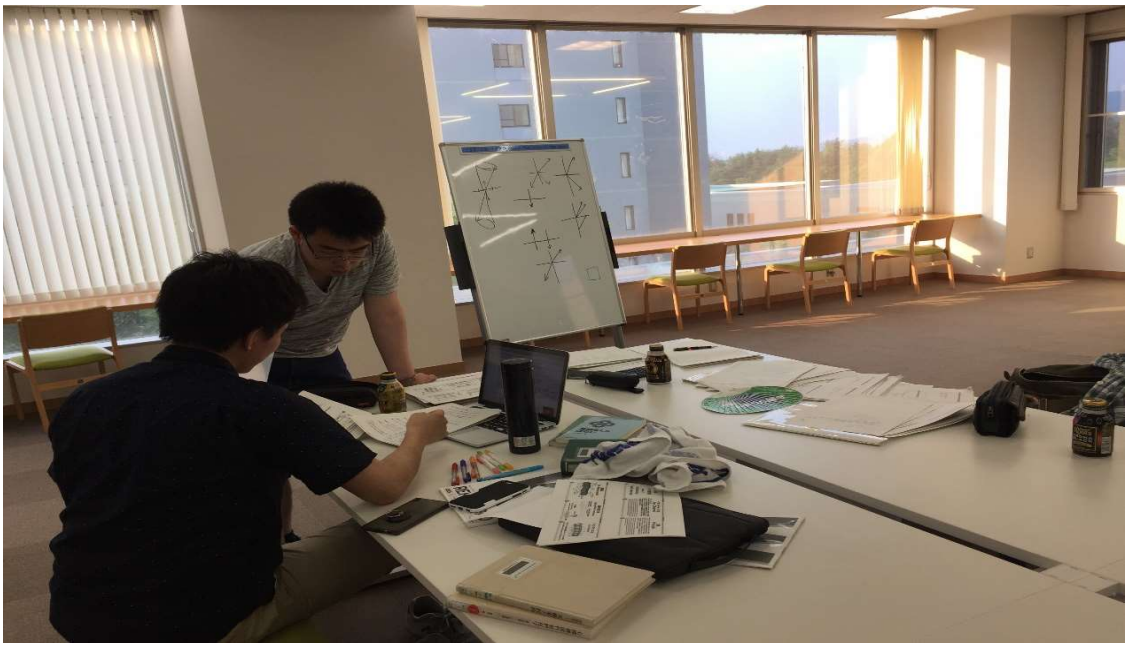

Figure 3.5 Out of class problem-based learning for course work at JAIST LC

3.9.4 Kanazawa University Learning Commons

The Kanazawa University Central Library provides the learning commons (LC) services to the learners for group study and various learning activities including information resources. These are the designated spaces for students to use for learning, education, research, classes, seminars, etc. Sufficient furniture including movable desks and chairs, whiteboards, projectors are in there for comfortable informal learning. Learners are allowed to talk and drink in the designated spaces during their group learning without disturbing others. To support the local and global learners for learning and make their academic life easy, the LC has sufficient tutoring staff to cooperate with them. The LC services have been located in different floors and designated spaces of the library which are mentioned below.

3.9.4.1 Book Lounge

It is the communication space for the learners near the entrance of the Central Library. Learners can arrange events like lecture, presentation, movie screening, etc. with prior appointment. They also can exhibit the club activities, research projects, etc. in the `Gallery α` exhibition space of this lounge. There is a café in this space which serves coffee to the learners. It is the most vibrant space of the LC where learners can talk,

Figure 3.6 Book lounge space of Kanazawa University Central Library LC

read newspapers, watch TV, eat and drink, communicate and collaborate for learning.

Figure 3.7 Book lounge coffee café in LC

3.9.4.2 Open Studio (I & II)

It is an open studio space where students can study in collaboration with peers or individuals. Students can use part of the studio for a class or a seminar with prior

Figure 3.8 Open studio of Central Library LC

appointment. They can use desks, chairs, projectors, whiteboard, screens, etc. during their learning activities.

3.9.4.3 Global Communication Studio

Mainly this space is designed to support the international students in their learning as well as information is provided to make their everyday life easy. To support the self-study of the international students the LC has Learning Concierge for International Students (LeCIS) service. On the other side, students self-learning is supported by the learning advisers of

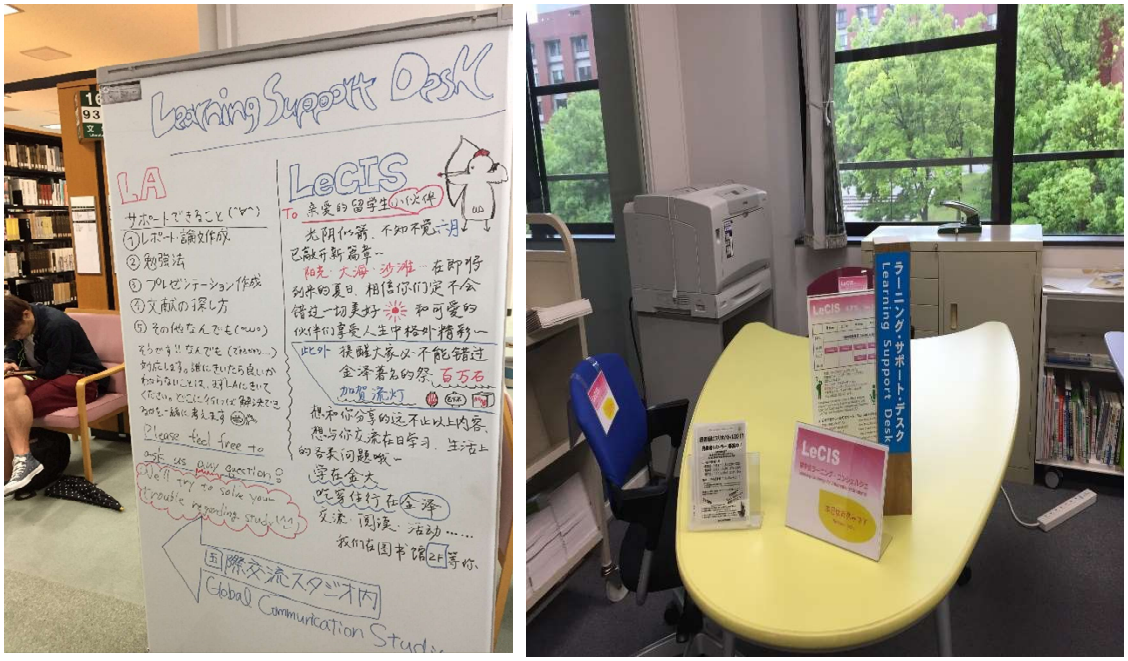

Figure 3.9 LeCIS and learning support desk in LC

this space. The global communication studio holds a unique learning strategy within the university campus. In everyday situations they try to make communication among the domestic and international students. For this reason, the LC arranges a foreign language learning program, discussion of different topics by the international students for domestic students.

3.9.4.4 Group Studio (A and B)

These are the highly designated spaces for group study of the learners. They can arrange seminars and workshops for their group study in these studios. To reach the course work problem conclusion they can practice and rehearsal their presentation in this dedicated space. Students need to reserve the studio before use.

Figure 3.10 Group Studio in LC

3.9.4.5 Polaris Studio

It is a bit of an isolated closed space in the LC for the students where they can study and arrange a class or seminar. The library also exhibits their precious materials, works of alumni and KU staff in this space in a display case.

3.10 Chapter Summary

The methodologies utilized in this study have been described in depth in this chapter. For this study, the quantitative research technique was chosen as an acceptable means of gathering data to answer the research question and objectives. The research design selected was a survey method, in which qualitative data was gathered to determine user-centered learning supported by Problems-Based Learning (PBL) at Learning Commons (LC) in academic libraries. The study conducted an online survey and therefore an online was emailed to the student mailing list of JAIST, printed copy to Kanazawa University Library authority and personally to some respondents of the Nagoya University. Purposive sampling method was used in the study to get deep insight about learning at LC. The sample included the bachelor, master, doctoral, certificate, special and visiting students of those three universities. The population of the study was the users of Learning Commons (LC) at Japan Advanced Institute of Science and Technology (JAIST) Library,

Kanazawa University Library and Nagoya University Library. In search of deep insight about learning at LC the study used a purposive sample by a confined survey participant to LC users. Collected data was analyzed by using Partial Least Squares – Structural Equation Modeling (PLS-SEM) method and presented the results in tables and figures.

Chapter 4: User-Centered Problem-Based Learning at Learning Commons

4.1 Introduction

Academic libraries provide resources and information, initiate spaces, and personal and virtual assistance to encourage learners to pursue their studies in an out of class environment (Lippincott, 2005). The user community of this age is demanding wider access to print, digital and multimedia sources of information and expecting assistance for their learning and research (MacWhinnie, 2003). Nowadays users are very techie and network dependent and want to search information independently. They are expecting interactive spaces to work in collaboration for their learning (Thomas & McDonald, 2005). Academic libraries have been facing a paradigm shift to user-centric approach to meet the diverse needs of users and introduced learning commons (LC) for meaningful services (Alam, Umemoto & Yoshida, 2016). LC provides physical, technological, social and intellectual spaces and offers learners, researchers and information professionals to pursue numerous learning and research curricula and activities (Bailey, 2006). It is a unique service from the library where librarians and commons staff collaborate with users for learning by teaching to solve the problems of assignments, research, writing, technical support, program on information literacy, faculty development, curricula development and so on. LC creates an environment of combined understanding of user needs together with library commons staff and users for their learning. Learners come and use the LC services and resources for solving their learning problems of course studies together with their group mates. Several studies have identified libraries as a social and learning place where learners and library staff are sharing and using information and knowledge for teaching and learning (Beagle, 1999; Jain, 2013; Maury, 2012; Somerville, & Collins, 2008). Learning at LC has created the context of knowledge sharing and acquisition among the learners on the way to conclude the problems. It is a collaborative and interactive social space which combines users, services, and resources to use for learning. Since LC has a different setting from the conventional classroom, they need to use different techniques and learning methods to lead to success. Learning methods can help the LC authority for better understanding of how users are using this space for their learning problem solving. Apart from that, they will be able to rearrange their learning

support services based on the learning methods followed by the users. Like other learning methods, problem-based learning (PBL) supports the learners to identify course studies problems, formulate inquiry, knowledge sharing and acquisition, determine the tentative solution and conclude for solving their learning problems. It is PBL that supports LC users by confirming out of class activity for identifying, formulating, searching, and solving learning problems (Khasawneh, 2013). This study investigates how the LC use experience of learners helps them to actively collaborate for creating meaning (knowledge) and solve coursework problems within an out of class PBL environment.

4.2 Objectives of the Study

The objective of this study is to understand how PBL methods prevail in an out of class environment and help to leverage the use of a dedicated learning space like LC. Thus, to see that LC use for learning supports PBL learners as well as helps them to create and share knowledge for problem conclusion and make the authority understand how the users are using this learning space. To achieve this, following research questions (RQs) were designed:

RQ1: How do learners use LC tools and services for solving their course studies learning problems?

RQ2: To what extent knowledge sharing and acquisition support users to identify learning problems, formulate inquiry, solution creation and problem conclusion in learning?

RQ3: How do LC users learning problem identification practice encourage them to learn and formulate inquiry?

RQ4: How does formulate inquiry motivate learners in solution creation of learning problems?

RQ5: How does solution creation positively direct learners for problem conclusion at LC?

RQ6: How do problem conclusion solve problems and complete user learning at LC?

There are five phases of the PBL method which leads the learners from problem identification to problem conclusion. LC users are coming to this space for solving their

course related problems. The authority of LC has furnished some dedicated services and facilities (lecture seminar, events, writing support, academic support, etc.) to help those learners without employing any learning method. It is evident that PBL supports the users learning problem solving in an out of class environment. This study is the first effort of its type to carry out empirical measures to check that the PBL method supports user`s learning at LC. The output of the study will give more insight of the authority to dig into the matter and employ need-based learning methods for users learning.

4.3 PBL at LC Structural Model

LC is a new model of service delivery system where librarians and users collaborate to meet the user`s learning needs. The purpose of this study is to see if PBL learners actively interact at learning commons to use its resources and spaces for sharing and obtaining knowledge in order to develop new meaning (knowledge) for addressing problems that have been posed in their coursework. PBL is an instruction-based method where students learn through facilitated problem solving that centers on a complex problem that does not have a single correct answer (Hmelo-Silver, 2004). It is a learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop solutions to a defined problem (Savery, 2006). Learning activities in PBL occur in three phases which have been conceptualized from Mergendoller et al. (2006) and English & Kitsantas (2013) to develop the theoretical model of the problem-based learning of users at learning commons. Later the Phase 2 (Guided Inquiry and Product/Solution Creation) was divided into two separate phases by the researchers and `formulate inquiry` and `solution creation` was determined as phases. Thus this study takes `problem identification`, `formulate inquiry`, `solution creation` and `problem conclusion` as PBL phases. Besides that, Hmelo-Silver (2004) has determined Knowledge Deficiencies as a phase of PBL cycle. Based on that phase this research adopts `knowledge sharing and acquisition` as a phase of the PBL process. All those five phases have been identified as the construct of the study and survey was conducted to check the relationship among the five constructs. Initial construct `problem identification` is the independent variable whereas rest of the constructs formulate inquiry`, `solution creation`, `problem conclusion`, `knowledge sharing and acquisition` and `LC use for learning` are the dependent variables.

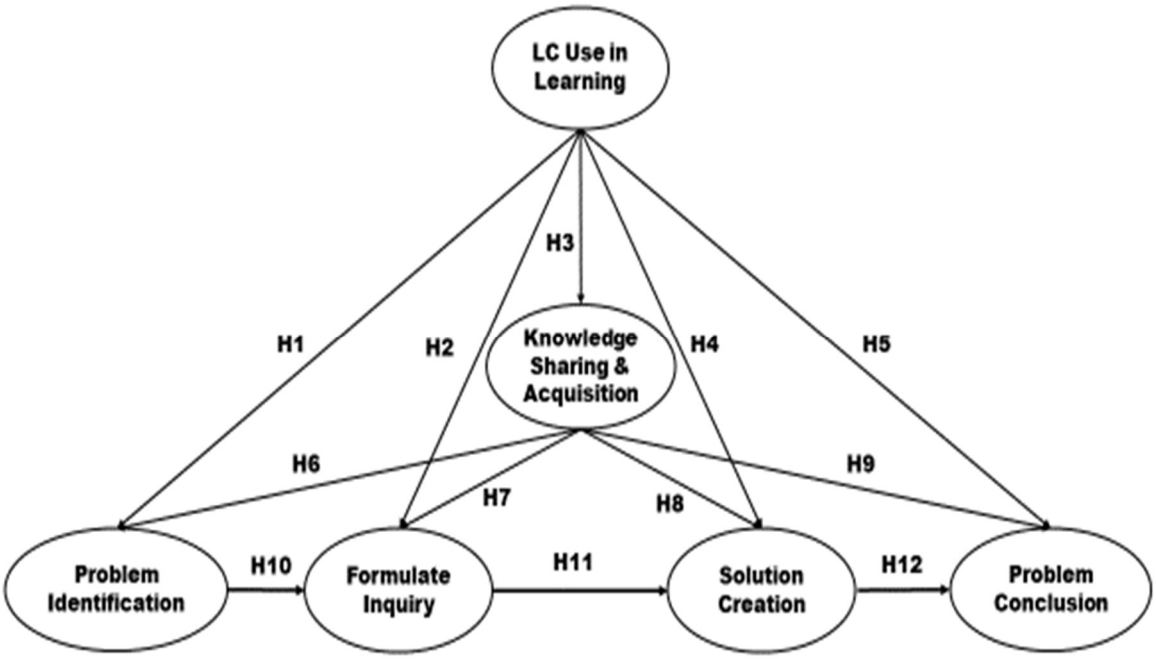

Figure 4.1 Hypothesized Model of Problem-Based Learning at Learning Commons

To initiate the research methodologically and to check the epistemological relationship among the constructs seven hypotheses were formulated.

4.4 Formulation of Hypothesis

Researchers have suggested formulating the research questions and hypothesis before the start of the study (Farrugia, Petrisor, Farrokhyar & Bhandari, 2010). Based on the PBL model of Mergendoller et al. (2006) and English & Kitsantas (2013) phases of problem identification, formulate inquiry, solution creation and problem conclusion has been considered as the construct of the study. In her PBL cycle study, Hmelo-Silver (2004) has determined knowledge deficiencies as one of the vital phases during learning. It was depicted that during learning learners apply their new knowledge to create ideas and evaluate the hypothesis towards creating solutions. In addition, as the research attempts to investigate the knowledge sharing perspective of users during learning, it takes knowledge sharing and acquisition as a phase of PBL. Based on those constructs this study formulates the mentioned hypothesis following deductive approach to guide the research.

4.4.1 LC Use for Learning (LCUL)

LC provides various services, spaces and resources for enhancing learning among the students in the library building with a combined effort of students, librarians, faculty, commons staff, tutoring staff, writing tutors and instructional designers. LC has integrated traditional library elements with the recent information technologies for creating a vibrant atmosphere to support the joint effort of learning with collaboration and interaction. The 'Commons Model' of Donald R. Beagle (2006) has combined three interrelated and interdependent levels of LC; the Physical Commons, the Virtual Commons and the Cultural Commons. The first level Physical Commons includes computer hardware, furnishings, designated spaces and traditional library collections (Beagle, 2006, p. 8). The second level, the Virtual Commons, contains the digital library collections, e-learning tools and online tools (search engines, productivity software, etc.) of the library. The third level, the Cultural Commons, is made up of social resources like workshops, tutoring programs, research collaborations, coaching etc. (Beagle, 2006, p. 8). Social, cultural and political envelope of cultural commons supports and extends the physical commons and virtual commons and these are the enabler for learning in LCs (Beagle, 2006, p. 5). The users of LC make use of services and resources from those three levels of commons in their course studies learning problem solving process. So, the LC gets connected with the four phases of PBL and also with the knowledge sharing and acquisition process of learning. Therefore, the study formulates the hypothesis as;

H1: LC use for learning has statistically significant relation with learning problem identification.

H2: LC use for learning has statistically positive relation with formulate inquiry.

H3: LC use for learning has statistically significant relation with knowledge sharing and acquisition.

H4: LC use for learning has statistically positive relation with solution creation of learning.

H5: LC use for learning has statistically significant relation with learning problem conclusion.

4.4.2 Knowledge Sharing and Acquisition (KSA)

Knowledge sharing and acquisition plays a role in every aspect of solving assigned learning problems. This activity helps the users to gather previous knowledge and share

knowledge among the groupmates and they integrate those with their own knowledge base and try to generate new ideas on the way to solve problems (Hmelo-Silver, 2004). Learner`s knowledge sharing and acquisition process has a contributing relationship with problem identification, formulate inquiry, solution creation and problem conclusion phases of PBL. Thus, it leads to the following hypothesis:

H6: Knowledge sharing and acquisition has statistically significant relationship with learning problem identification at LC.

H7: Knowledge sharing and acquisition has statistically positive effects on formulate inquiry.

H8: Knowledge sharing and acquisition has statistically significant influence on solution creation.

H9: Knowledge sharing and acquisition has statistically positive relation with problem conclusion.

4.4.3 Problem Identification (PI)

Problem identification process develops a clear idea about the learning problem (English & Kitsantas, 2013; Hmelo-Silver, 2004). Students use LC for solving their learning problems such as assignments, presentations, projects and examinations. Through various learning activities like discussion, sharing, feedback, etc. with group mates they try to understand and define the problem. After the completion of the problem identification phase the next phase formulate inquiry begins. Therefore, the study formulates the hypothesis as;

H10: Problem identification practice has statistically significant relation with formulate inquiry.

4.4.4 Formulate Inquiry (FI)

Through inquiry students who are working in LC try to create the questions that they need to know for solving the problems (English & Kitsantas, 2013; Hmelo-Silver, 2004). They gather information/knowledge from different sources and share it among group mates to find the knowledge gap for further query. In this way they develop hypotheses for creating best possible solutions of the problem. Therefore, it formulates the hypothesis;

H11: Formulate inquiry has statistically significant relation with solution creation.

4.4.5 Solution Creation (SC) and Problem Conclusion (PC)

In this stage students start thinking about the possible solution of the problem. They try to make sense of the collected knowledge by developing new ideas and searching for the best solution (Allen, Donham, & Bernhardt, 2011; English & Kitsantas, 2013). It leads them to the final phase of problem conclusion where students are prepared for submitting their overall learning outcome and process outcome. LC learners use the presentation support center, collaborative learning spaces, and community spaces to work with group mates for creating solutions to their learning issues and try to prepare the tentative conclusion (Lippincott, 2006; McMullen, 2008). During their rehearsal of the candidate solution in LC presentation support spaces they integrate group feedback and revise the solution and try to evaluate its accuracy. Through numerous practices and revisions, they combine the collected knowledge with the old concept and prepare the final presentation for best conclusion. Thus, it leads to the following hypothesis:

H12: Solution creation has statistically significant relation with problem conclusion.

4.5 Methodology

The aim of the survey is to get a deep insight about the problem-solving practice of learners at LC and to ascertain the influence of knowledge sharing in the learning problem solving cycle. The study relied upon the quantitative approach to define the problem and conducted the survey for collecting data. As the quantitative approach is a more scientific and reliable one to dig into the problem, a structured questionnaire was circulated to the respondents (Eyisi, 2016). The survey was conducted online during June and July 2017.

4.5.1 Survey Instrument – Online Questionnaire

An online questionnaire was used to collect data for the survey, and we have used the Google Form platform as an online survey collection tool. The questionnaire consisted of 37 questions with 26 close-ended questions (e.g., Q1 - Q26). In target of getting scaled responses from the users a 7-point Likert scale was used ranging from 1= strongly disagree to 7= strongly agree. Some of the questions had multiple selection options while some of them had a single response option with open-ended questions.

The instrument comprises 7 sections including the introductory section in the beginning which has described the background, participation, confidentiality, guideline, definition

of key terms and contact information. In the next five sections, questions for 6 constructs were arranged (Q1 – Q26). Just to avoid the congested condition in the sections the questions of knowledge sharing and acquisition construct were distributed among the four other constructs. Last two sections have been arranged to gather users' LC use experience and academic status. The theme of this structured questionnaire covers the learning problem-solving practice of the users at Learning Commons of the library.

4.5.2 Survey Design and Sample

The population of the study was the users of Learning Commons in libraries including bachelor, master, doctoral, certificate, special and visiting students of the institutions. For the study, the participation in the survey was opened to Japan Advanced Institute of Science and Technology (JAIST) and Kanazawa University (KU) students as those institutions are in Japan. Apart from this, there are few students from Nagoya University (NU) with the researchers' personal contact. Accordingly, those two academic libraries of JAIST and Kanazawa University comprised the population of the study. To participate in the survey, the JAIST student mailing list was used to request the students. Kanazawa University Library authority used a poster in the entrance and LC area to ask their users to participate in the online survey.

In search of deep insight about learning at LC the study used a purposive sample by a confined survey participant to LC users. For widening the global view of the study certificate, special and visiting students were included who were studying in the mentioned three Japanese universities. Which has brought the opportunity to get varied responses from the university students of the USA, Canada, France, Kosovo, and China. As the Japanese students are not very familiar with the English language, five LC instructors of Kanazawa University extended their significant effort to make students understand the questionnaire.

4.5.3 Development of Constructs and Variables

In determining the complex process of problem-based learning at LC the constructs and variables were developed based on previous studies and in some cases self-developed. The proposed model has six key constructs which have been checked by 26 items of variables. Demographic variables were also added to get the users` experience of using LC and their personal details of academic status.

LC is an interactive space in the library where users come to use it together with their peers to solve learning problems. Here LC put an effort with their integrated resources, tutoring staff and spaces to help to solve the coursework problems. Learners do their collaborative work to identify the learning problems that they need to solve with the out of class ability. After determining the learning problems users progressively go for next steps to formulate inquiry, solution creation, knowledge sharing and acquisition and problem conclusion. As a whole the learning process ascertained that LC use for learning is the independent variable whereas PBL phases up to problem conclusion is the dependent variable of the study.

Table 4.1 Constructs and questions included in the questionnaire

Construct	Item scale	Question	Theoretical foundation
LC Use for Learning (LCUL)	LCUL1	We use LC computer devices, designated space and library collection during learning	Beagle, 2006
	LCUL2	LC portals, digital library collections, e-learning tools, productivity software helps us to prepare the solution	Beagle, 2006
	LCUL3	LC social resources like workshops, tutoring programs, research collaborations and coaching help to generate new idea and create solution	Beagle, 2006
Knowledge Sharing and Acquisition (KSA)	KSA1	We discuss about collected knowledge to understand new findings	English & Kitsantas, 2013
	KSA2	Discussion and sharing idea and knowledge helps me to innovate new ideas	English & Kitsantas, 2013
	KSA3	In group discussion we integrate the collected knowledge	Somerville & Collins, (2008)
	KSA4	By writing results we combine knowledge and develop new concepts with old one	Self-developed
Problem Identification (PI)	PI1	Outside of classroom LC gives me the opportunity to work for solving learning problems with groupmates	Khasawneh, 2013
	PI2	Here we determine the driving question that we need to answer for solving the problem	English & Kitsantas, 2013
	PI3	Group learning helps me to understand the broad nature of the problem	Khasawneh, 2013
	PI4	LC learning helps me to organize ideas by gathering previous knowledge	Self-developed
	PI5	Learning in LC is improving my problem-solving skills	English & Kitsantas, 2013

Formulate Inquiry (FI)	FI1	In LC group work several questions and unknown issues arise that we need to know	Khasawneh, 2013
	FI2	I can understand what information we need to know further	English & Kitsantas, 2013
	FI3	We plan to take help from experts and search information	English & Kitsantas, 2013
	FI4	Here I share and explain my ideas	English & Kitsantas, 2013
	FI5	Group mates teaches each other about the new findings	Self-developed
Solution Creation (SC)	SC1	During LC learning I can determine which topic is important to know in the beginning	Somerville, & Collins, (2008)
	SC2	We assign group or individual tasks like information collection, report writing, creating presentation, etc. for solving the problems	Somerville, & Collins, (2008)
	SC3	We work to create the best possible presentation or solution of the problem	Somerville, & Brar, (2006)
	SC4	While working in LC we rehearsal and revision our tentative presentation or solution	Tick, A. (2007)
	SC5	LC programs (J-Beans lecture seminars, events) helps me to generate the best solution	Somerville, & Collins, (2008)
Problem Conclusion (PC)	PC1	Through discussion we summarize relevant knowledge and identify what is needed to know more	Self-developed
	PC2	Through practice and preparation, we try to decide the best ways for solution	Khasawneh, 2013
	PC3	Based on group feedback we revise the presentation and evaluate its' accuracy	Khasawneh, 2013
	PC4	While preparing the final solution we still find some unanswered issues	Khasawneh, 2013

4.5.4 Data Analysis

The study conducted an online survey and used the Google Form platform as a survey collection tool. Primarily JAIST and Kanazawa University (KU) students were determined as the population of the study and later some students at Nagoya University (NU) were included with the researchers personal contact. In a target of broadening the insight about the phenomenon, the certificate, special and visiting students at those universities were purposely included. Which has brought the opportunity to get responses from the university students of the USA, Canada, France, Kosovo, and China. The

questionnaire comprises five constructs including items of variables which were determined from earlier studies and researchers' self-experience. Based on the constructs and demographic variables all questions were arranged into seven different sections.

The analysis of the questionnaire data for this study was mostly done with the SPSS™ 25 program and also MS-Excel. The online dataset was first tabulated in MS-Excel from the original responses and then converted into SPSS. Collected dataset were tabulated in three (JAIST, KU, and NU) different projects and they were accumulated in a single Excel file. From the three universities a total of 105 students participated in the survey. Survey instruments were mailed to the JAIST and KU students using student mailing lists. As it was not possible to predict how many students would get the mail, it was difficult to calculate the response rate of the survey. The study adopted partial least squares – structural equation modeling (PLS-SEM) method to examine the factors or variables and their interaction with the dependent variable.

4.6 Survey Findings and Hypothesis Test

This section of the study presents the findings from the data that was collected through online questionnaire surveys conducted on LC users of university libraries. The findings section has two parts: Part I presents the demographic data of the respondents participating in the survey, and Part II Partial Least Squares – Structural Equation Modeling (PLS-SEM) analysis and test of hypothesis.

4.6.1 Part I: Demographics of Respondents

In research it is a usual practice to report the response rate of the respondents. But in many cases recent research has mentioned that it is not easy to regularly report the online survey response rate (Zhang, 2000). In their study Cook, Heath, & Thompson (2000) has stated that the sample which is less than 1% of the population is even significantly more demonstrative than a sample of 50% or 60% of the population. Recent research has found that surveys with extremely low response rates are more accurate than surveys with substantially greater response rates (Krosnick, 1999). In this study it was not possible to determine the sample size of the survey because it was unidentified how many students received the email of the questionnaire. There were 105 valid respondents to this online questionnaire survey. Except one, all of them have participated from within Japan.

4.6.1.1 Gender of Respondents

Among the 105 respondents, table 4.2 shows that 37.1% (39) were female and 62.9% (66) were male respondents. The age range of the male and female respondents were between 19 to 35 years. Most of the female respondents' age ranges between 19 to 25 years, on the other hand male respondents age ranges between 19 to 27 years. The table shows that a big portion of 15 male and 9 female respondents belong to 20 years of age as well as 13 male and 6 female belong to 24 years of age.

Table 4.2 Gender of the respondents (N=105)

Year of Age	Female	Male	Total
19	4	3	7
20	9	15	24
21	3	5	8
22	2	3	5
23	5	7	12
24	6	13	19
25	6	7	13
26	0	2	2
27	2	5	7
28	1	0	1
29	0	1	1
30	0	1	1
31	1	0	1
32	0	1	1
34	0	1	1
35	0	2	2
Total	**39 (37.1%)**	**66 (62.9%)**	**105**

4.6.1.2 Age Group

The mean age of the respondents is 23.27 and the median age is 23.00. A majority of 75 respondents (71.4%) belonged to the age group 19 – 24. The table 4.3 indicated that as

Table 4.3 Age group of the respondents (N=105)

Age Group	Frequency	Percent	Statistics	
19 – 24	75	71.4	Mean	23.27
25 – 30	25	23.8	Median	23.00
31 – 35	05	04.8	Minimum	19
Total	105	100.0	Maximum	35

the age group increased and the number of respondents decreased. The second largest part of the respondents were in the age group of 25 – 30, which has 23.8% of respondents. It is noticeable here that the usual age ranges of learning common users are between 19 to 30 years.

4.6.1.3 Academic Institutions

The majority of respondents belong to the Japanese universities and all together it has formed about 95% from the JAIST, Kanazawa University and Nagoya University. The survey included five universities from outside of Japan as their students were studying in these three Japanese universities as certificate, special and intern students. 50.2% of the respondents had participated from Kanazawa University and 42.9% were from Japan Advanced Institute of Science and Technology (JAIST). These two universities have formed 93.1% of the total responses. There were 5 international students participating in the survey as they were studying in the surveyed universities as certificate, special and intern students. It has given the opportunity to include five universities from outside of Japan. Those five universities are from Kosovo, Canada, USA, China and France.

Table 4.4 Academic institutions of the respondents (N=105)

Academic Institution	Country	Respondent	Percent
Central European University	Kosovo	1	1.0
JAIST (Japan Advanced Institute of Science and Technology)	Japan	45	42.9
Kanazawa University	Japan	53	50.2
Mount Royal University	Canada	1	1.0
Nagoya University	Japan	2	1.9
New Platz State University of New York	USA	1	1.0
South West University of Science and Technology	China	1	1.0
University Toulouse	France	1	1.0
Total		105	100.0

4.6.1.4 Academic Status

Among the respondents, 46.7% (49 respondents) were both the Bachelor and Master level students which has coincidently made an equal position in the survey. Other than that, 4.8% (5 respondents) were Doctoral students. There were also 1.0% each of Certification Course and Special Auditor students. Among the 49 Bachelor students there were 20

female and 29 male students. On the other side, there were 17 female and 32 male students amongst the 49 Master students.

Table 4.5 Academic status of the respondents (N=105)

Academic Status	Frequency	Percent	Female	Male
Bachelor	49	46.7	20	29
Certification Course	1	1.0	0	1
Doctoral	5	4.8	2	3
Master	49	46.7	17	32
Special Auditor Student	1	1.0	0	1
Total	105	100.0	39	66

4.6.1.5 Country of Residents

The vast majority of survey responses came from Japanese students as the survey was conducted in three Japanese universities. Out of 105 responses the majority of 56.2%

Table 4.6 Country of residents of the respondents (N=105)

Country of residents	Frequency	Percent	Female	Male
Australia	1	1.0	0	1
Bangladesh	6	5.7	3	3
Belgium	2	1.9	1	1
China	18	17.1	8	10
France	1	1.0	1	0
Indonesia	3	2.9	1	2
Japan	59	56.2	21	38
Korea	1	1.0	0	1
Kosovo	1	1.0	1	0
Mongolian	1	1.0	1	0
Russia	1	1.0	1	0
Swaziland	1	1.0	0	1
Thailand	4	3.8	0	4
USA	1	1.0	0	1
Vietnam	5	4.8	1	4
Total	105	100.0	39	66

were Japanese (59 respondents) students. They were followed by 17.1% China (18 respondents), 5.7% Bangladesh (6 respondents), 4.8% Vietnam (5 respondents), 3.8%

Thailand (4 respondents), and 2.9% of Indonesian (3 respondents) students. Out of 59 Japanese responses, there were 21 female and 38 male students and in 18 Chinese responses there were 8 female and 10 male students.

4.6.1.6 Country of Response

Table 4.7 reveals that 95.2% of responses have come from Japan and mainly from JAIST, Kanazawa University and Nagoya University. The rest were coming from 5 other countries as their students were studying as intern, special or certificate students in the surveyed universities. Thus, the survey responses have come from 6 countries and 2 of each response has come from the continent of Asia, Europe and North America.

Table 4.7 Country of response of the respondents (N=105)

Country	Frequency	Percent
Canada	1	1.0
China	1	1.0
France	1	1.0
Japan	100	95.2
Kosovo	1	1.0
USA	1	1.0
Total	105	100.0

4.7 Part II: Partial Least Squares–Structural Equation Modeling (PLS-SEM) and Hypothesis Test

The study has employed Partial Least Squares-Structural Equation Modeling (PLS-SEM) which is a widely accepted method for the research that has sensible amount of data and theoretical information (Alolah, Stewart, Panuwatwanich, & Mohamed, 2014; Hair, Risher, Sarstedt & Ringle, 2019). As suggested in this method the study used a two-step model validation process that first examines and validates the measurement model and then tests the proposed theoretical structure (Babin & Attaway, 2000; Gerbing & Anderson, 1992). Several statistical analyses were performed which includes the descriptive statistics of mean, standard deviation, skewness, kurtosis and Cronbach`s alpha related with the profile of sample (Sekaran, 2003). In addition, factor loading, composite reliability (CR) and average variance extracted (AVE) was employed to check

the reliability and validity of the dataset. The analysis also includes a test of hypothesis to validate the proposed structural model. The statistical analysis techniques used in this research are mentioned as follows.

4.7.1 Partial Least Squares (PLS) Analysis

As suggested in Partial Least Squares (PLS) method the study first examines and validates the measurement model (Babin & Attaway, 2000; Gerbing & Anderson, 1992).

4.7.1.1 Measurement Model

To examine and validate the measure model several statistical analyses were carried out, including descriptive statistics such as mean, standard deviation, skewness, kurtosis, and Cronbach's alpha for the sample profile (Sekaran, 2003). The dataset's reliability and validity were also tested using factor loading, composite reliability (CR), and average variance extracted (AVE). The following are the statistical analysis approaches employed in this study.

4.7.1.1.1 Internal Consistency and Descriptive Statistics

The descriptive statistical analysis of the six constructs LC Use for Learning (LCUL), Knowledge Sharing & Acquisition (KSA), Problem Identification (PI), Formulate Inquiry (FI), Solution Creation (SC) and Problem Conclusion (PC) was conducted in order to gain

Table 4.8 Internal consistency and descriptive statistics

Construct	Item	Mean	Standard Deviation	Skewness	Kurtosis	Cronbach's Alpha (≥ 0.70)
LC Use for Learning (LCUL)	3	5.349	0.769	-0.751	1.343	0.746
Knowledge Sharing & Acquisition (KSA)	4	5.374	0.932	-0.531	0.651	0.750
Problem Identification (PI)	5	5.337	0.893	-0.818	1.241	0.740
Formulate Inquiry (FI)	5	5.356	0.921	-0.817	1.273	0.779
Solution Creation (SC)	5	5.276	0.972	-0.864	0.452	0.772
Problem Conclusion (PC)	4	5.260	0.944	-0.578	0.565	0.744

insight into the variables. Mean, standard deviation, skewness and kurtosis was calculated as part of the process. The LC users of the study have shown a positive attitude towards

the problem-solving process throughout the problem identification to problem conclusion steps and the mean resembles a high positivity ranging from 5.374 to 5.260 (in a scale of 1 to 7). The standard deviations for all the variables are less than one and they are ranging from 0.893 to 0.972, which indicates the item scores are relatively close to mean scores. The skewness of the latent variables ranges from -0.531 to -0.864 and kurtosis ranges from 1.3 to 0.452. Kline (2010) recommends that the indices of skewness should be below 3.0 and the kurtosis is 8.0. Last of all Cronbach's alpha (1951) measures the internal consistency between items in a scale. Results of Cronbach's alpha have exceeded the recommended value of 0.70 (Table 4.8) and show strong consistency among the items. So the data of this study are found to be normal for the purpose of partial least squares – structural equation modeling (PLS-SEM) and multiple regression analysis for hypothesis testing.

4.7.1.1.2 Indicator Reliability and Convergent Validity

In examining the measurement model the primary step is to assess the indicator loading. The expected loading value is above 0.70 as the construct can explain 50 percent variance of the indicator (Hair, Risher, Sarstedt & Ringle, 2019). In this study the loadings have been adjusted according to the recommendations of Ping (2009) for having improved the value of loading. Thus, the loading ranges from 0.599 to 0.892 (Table 4.9) and items are not deleted as there are no loadings below 0.50 (Chen & Tsai, 2007; Chin, 1998; Hair, Black, Babin, & Anderson, 2010). As a result, they showed a strong reliability of indicator loading and contributed to having increased composite reliability (CR) and average variance extracted (AVE). Convergent validity is the extent which helps to measure the level of correlation of multiple indicators and other measures of the same construct (Ab Hamid, Sami, & Sidek, 2017). For testing the convergent validity of the scale composite reliability (CR) and average variance extracted (AVE) has been examined (Thomas & Veloutsou, 2013). Reliability proves the internal consistency to which the individual items that constitute a test (scale) correlate with one another or with the test total. The composite reliability (CR) has been regarded as an alternative measure to Cronbach's alpha as it`s items are unweighted (Ando et al., 2005). The composite reliability (CR) and average variance extracted (AVE) coefficient are related with the quality of a measure. The value of 0.70 and higher is required in composite reliability (CR) to be adequate for

Table 4.9 Factor loading, composite reliability (CR) and average variance extracted (AVE) coefficient

Construct	Item	Factor Loading (≥ 0.70)	Composite Reliability (CR) (≥ 0.70)	Average Variance Extracted (AVE) (≥ 0.50)
LC Use for Learning (LCUL)	LCUL1	0.715	0.7664	0.52445
	LCUL2	0.803		
	LCUL3	0.646		
Knowledge Sharing & Acquisition (KSA)	KSA1	0.837	0.874	0.636
	KSA2	0.676		
	KSA3	0.803		
	KSA4	0.860		
Problem Identification (PI)	PI1	0.668	0.839	0.512
	PI2	0.683		
	PI3	0.758		
	PI4	0.796		
	PI5	0.662		
Formulate Inquiry (FI)	FI1	0.609	0.864	0.564
	FI2	0.670		
	FI3	0.761		
	FI4	0.889		
	FI5	0.795		
Solution Creation (SC)	SC1	0.599	0.838	0.513
	SC2	0.663		
	SC3	0.867		
	SC4	0.629		
	SC5	0.787		
Problem Conclusion (PC)	PC1	0.828	0.855	0.600
	PC2	0.689		
	PC3	0.666		
	PC4	0.892		
	LCUL3	0.646		

reliability. In this study the CR of all the six constructs are above the recommended value and they range from 0.838 to 0.874. The next step of examining convergent validity is measuring average variance extracted (AVE). Table: 4.9 shows that the AVE of six constructs have satisfactorily crossed the recommended value 0.50. AVE of this study ranges from 0.512 to 0.636 and it indicates a strong convergent validity of the constructs.

4.7.1.1.3 Discriminant Validity - Fornel and Larcker

Discriminant validity is the process of measuring empirically how the constructs are differing from one another (Afari, 2013). For assessing the discriminant validity, the square root of average variance extracted (AVE) of each construct was followed as suggested in Fornel and Larcker (1981). The discriminant validity appears when comparing the square root of average variance extracted (AVE) **(in bold)** with the

Table 4.10 Square root of AVE *(in bold)* and correlations between constructs

Construct	Problem Identification	Formulate Inquiry	Knowledge Sharing & Acquisition	Solution Creation	Problem Conclusion	LC Use for Learning
Problem Identification	**0.715**					
Formulate Inquiry	0.660**	**0.751**				
Knowledge Sharing & Acquisition	0.643**	0.865**	**0.797**			
Solution Creation	0.551**	0.738**	0.723**	**0.716**		
Problem Conclusion	0.690**	0.756**	0.790**	0.536**	**0.774**	
LC Use for Learning	0.651**	0.702**	0.740**	0.647**	0.754**	**0.724**

**. Correlation is significant at the 0.01 level (2-tailed)

correlation coefficients of each construct. This study finds that formulate inquiry - knowledge sharing & acquisition and formulate inquiry - problem conclusion is having slight variances. The differences between them are 0.114 and 0.005 which can be ignored as it has been reported that Fornel and Larcker do not always work well with the loadings having strong values (Ab Hamid, et al. 2017; Hair et al., 2019). Moreover, the discriminant validity of this study can be accepted as the factor loadings below 0.70 was not deleted. Lastly, the other four construct square roots of AVEs are higher than the values of its columns and absolutely they have established the discriminant validity. Thus, the measurement model has established the internal consistency, indicator reliability, convergent validity and discriminant validity adequately.

4.7.2 Structural Model and Hypothesis Test

As a part of the two-step model validation process of structural equation modeling (SEM), the last step is to validate the structural model. Figure 4.1 shows the hypothesized structural model which has been delineated based on the literature review of chapter 2. Linear regression was performed to test the proposed structural model and hypothesis to fit the model by checking the relationship of dependent and independent variables (Van Tonder, & Petzer, 2018). The structural model comprises five latent constructs that have twenty-three observable variables. It shows the path relationships among the dependent and independent variables as hypothesized in the study. To test the competence of the structural model the factor loading, path coefficient (β) and coefficient of determination ($R^{2)}$ were employed (Chin, 1998). For computing the path coefficient (β) and its subsequent t-values and p-values linear regression were carried out using the SPSS 25 program.

The overall fit of the model is determined by the coefficient of determination ($R^{2)}$ of each construct (Martinez-Ruiz and Aluja- Banet, 2009). The study has followed the estimates of 0.04 as minimum, 0.25 as moderate and 0.64 as strong for the coefficient of determination ($R^{2)}$ as suggested by Ferguson (2009) for social science research. The structural model has formulated twelve hypotheses *H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H11* and *H12*. It has appeared from the analysis that all the hypotheses have been supported. The results of coefficient of determination ($R^{2)}$ shows the explanatory power of the research model and moderate to strongly support all the hypotheses. Table 4.11 has listed the results of the hypothesis testing and all the hypotheses were strongly supported. The first phase of the structure model shows the relationship of independent variable of LC Use for Learning (LCUL) with the dependent variable of PBL phases of Problem Identification (PI), Formulate Inquiry (FI), Knowledge Sharing and Acquisition (KSA), Solution Creation (SC) and Problem Conclusion (PC). It specifies that in hypothesis *H1* and *H2* LC use for learning has statistically significant relation with Problem Identification (PI) and Formulate Inquiry (FI) has 41% ($R^2 = 0.41$) and 50% ($R^2 = 0.50$) of inner relationship with the PBL learners problem dealing phases. The hypothesis *H3* indicates that LC use for learning has statistically significant positive relation with learners Knowledge Sharing and Acquisition (KSA) and helping to create 55% (R^2 =

0.55) new knowledge during learning. Hypothesis *H4* and *H5* shows the relationship between LC use for learning with Solution Creation (SC) and Problem Conclusion (PC). It depicts a statistically significant relationship with *H4* of 40% (R^2 = 0.40) and *H5* of 74% (R^2 = 0.74).

Table 4.11 Results of Structural Equation Model (SEM) and hypothesis testing

Hypothesis	Path	Coefficient (β)	R^2	t Value	Sig. (p)	Test Status
H1	LCUL ⟶ PI	0.64	0.41	8.43	0.00***	Supported
H2	LCUL ⟶ FI	0.71	0.50	10.18	0.00***	Supported
H3	LCUL ⟶ KSA	0.74	0.55	11.16	0.00***	Supported
H4	LCUL ⟶ SC	0.63	0.40	8.30	0.00***	Supported
H5	LCUL ⟶ PC	0.86	0.74	11.44	0.00***	Supported
H6	KSA ⟶ PI	0.64	0.41	8.53	0.00***	Supported
H7	KSA ⟶ FI	0.87	0.75	17.52	0.00***	Supported
H8	KSA ⟶ SC	0.72	0.52	10.62	0.00***	Supported
H9	KSA ⟶ PC	0.79	0.62	13.10	0.00***	Supported
H10	PI ⟶ FI	0.66	0.44	8.93	0.00***	Supported
H11	FI ⟶ SC	0.74	0.55	11.10	0.04**	Supported
H12	SC ⟶ PC	0.84	0.70	6.44	0.03**	Supported

**** p<.001, ** p<. 05, * p<. 01, based on two-tailed test*

The second phase of the model shows the relationship of the independent variable Knowledge Sharing and Acquisition (KSA) with the dependent variables of PBL Phases. The hypothesis *H6* and *H7* explains that Knowledge Sharing and Acquisition (KSA) has 41% (R^2 = 0.41) and 75% (R^2 = 0.75) of variance (of inner relationship) with Problem Identification (PI) and Formulate Inquiry (FI) and it shows the statistically significant relationship of the two hypotheses. Moreover, in hypothesis *H8* and *H9*, Knowledge Sharing and Acquisition (KSA) can be accounted for Solution Creation (SC) and Problem Conclusion (PC) to the extent of 52% (R^2 = 0.52) and 62% (R^2 = 0.62).

The last stage of the structural model shows the relationship of the independent variable Problem Identification (PI) with the rest of PBL phases and displays statistically significant relationships among them. In hypothesis *H10* Problem Identification (PI) having 44% ($R^2 = 0.44$) of variation (to encourage the learners) in connection with the Formulate Inquiry (FI). On the other side, hypothesis *H11* interprets that 55% ($R^2 = 0.55$) of Formulate Inquiry (FI) influences learners for Solution Creation (SC). According to hypothesis *H12*, Solution Creation (SC) including all the independent variables can interpret Problem Conclusion (PC) to the extent of 70% ($R^2 = 0.70$). Thus, the coefficient of determination ($R^{2)}$ resolves that the model fits near strongly.

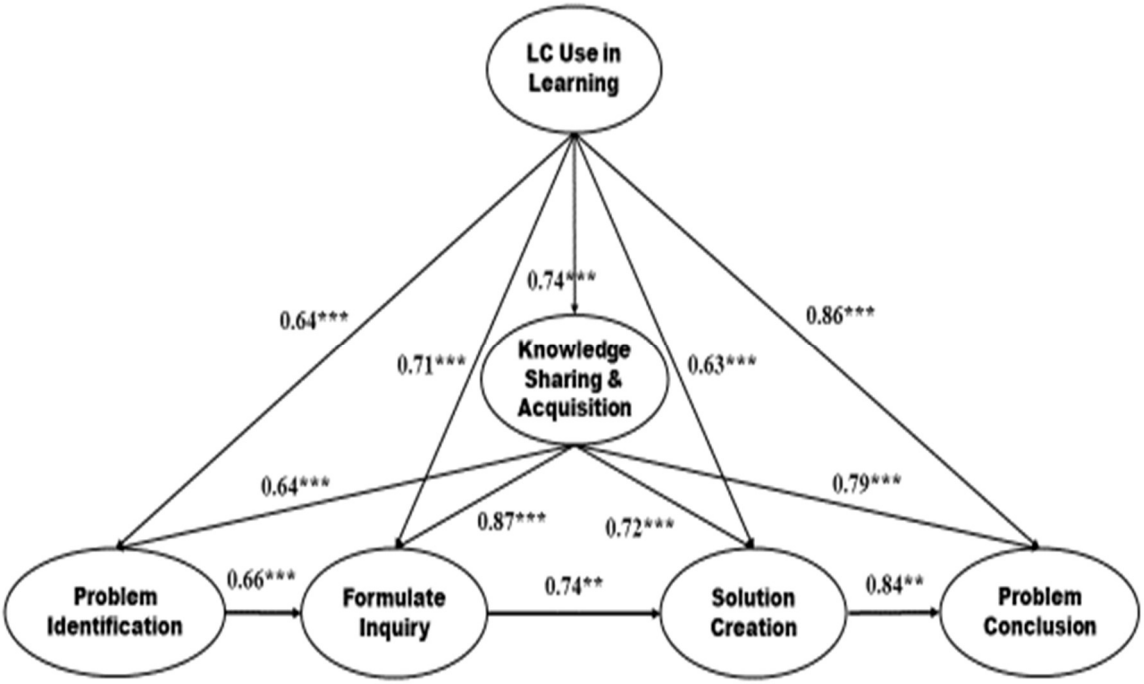

Figure 4.2 Structural Model of Problem-Based Learning at Learning Commons

Finally, the partial least squares-structural equation modeling (PLS-SEM) analysis (**Table 4.11 and Figure 4.2**) shows the path coefficient (β), t-values and p-values for test of hypothesis. The table indicates that all path of the twelve hypotheses (*H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H11* and *H12*) are statistically significant and positive with path coefficient (β) and p-value.

For testing the hypothesis, we have observed the relationship of LC Use for Learning (LCUL) as independent variable with Problem Identification (PI), Formulate Inquiry (FI), Knowledge Sharing and Acquisition (KSA), Solution Creation (SC) and Problem Conclusion (PC) as dependent variable. As is evident from Table 4.11, in LC Use for Learning (LCUL) is found (*H1*) significantly encourages Problem Identification (PI) ($\beta = 0.64$, $p < 0.001$). In the same way, where the LC Use for Learning (LCUL) has (*H2* and *H3*) statistically significant relationship with Formulate Inquiry (FI) ($\beta = 0.71$, $p < 0.001$) and Knowledge Sharing and Acquisition (KSA) ($\beta = 0.74$, $p < 0.001$). PBL learners use LC resources and services for their problem solution, and it has been found that (*H4* and *H5*) there is a significant relationship of LC Use for Learning (LCUL) with Problem Solution (SC) ($\beta = 0.63$, $p < 0.001$) and Problem Conclusion (PC) ($\beta = 0.86$, $p < 0.001$).

In this way to fit the structural model, we have observed the relationship of Knowledge Sharing and Acquisition (KSA) as independent variable with the PBL phases of Problem Identification (PI), Formulate Inquiry (FI), Solution Creation (SC) and Problem Conclusion (PC) as dependent variable. It is found statistically significant that (*H6 and H7*) Knowledge Sharing and Acquisition (KSA) supports the positive relationship with Problem Identification (PI) ($\beta = 0.64$, $p < 0.001$) and Formulate Inquiry (FI) ($\beta = 0.87$, $p < 0.001$). In addition, there has statistically significant relationship (*H8* and *H9*) among Knowledge Sharing and Acquisition (KSA) with Solution Creation (SC) ($\beta = 0.72$, $p < 0.001$) and Problem Conclusion (PC) ($\beta = 0.79$, $p < 0.001$).

The relationship among PBL phases of the model has also been checked to see the problem-solving process of the learners where Problem Identification (PI) was the independent variable and Formulate Inquiry (FI), Solution Creation (SC) and Problem Conclusion (PC) was dependent variable. It is found statistically significant that the hypothesis (*H10*) supports the positive relationship of Problem Identification (PI) with Formulate Inquiry (FI) ($\beta = 0.66$, $p < 0.001$). While Formulate Inquiry (FI) impacts positively (*H11*) on Solution Creation (SC) ($\beta = 0.74$, $p < 0.05$). Lastly, (*H12*) Solution Creation (SC) is having a positive influence on Problem Conclusion (PC) ($\beta = 0.84$, $p < 0.05$) and shows that all the independent variables have positive impact on dependent variables.

4.8 Findings

As was mentioned earlier in the literature review, there is a gap in the literature that Learning Commons supports users learning in an out of class space. Here the learners use LC resources and services for creating meaning to solve coursework problems as assigned by their faculty. Beagle (2006) mentioned that LC is an informal learning space which ensures a constructivist environment by facilitating the contextual, active, and social engagement of learners. But there was lack of evidence that users are employing constructivist learning methods in LC for their learning. To shed light on this under-research topic, this research took the investigation to seek out clear insights that users are employing learning methods for engaging in learning in an out of class facility. The findings of the research questions and the analysis of PLS-SEM measurement and structural model of the study are reported in earlier tables. The findings that have emerged as a result of the research questions are mentioned in the following section.

RQ1: How do learners use LC services and tools for solving their course studies learning problems?

Learners use the Physical Commons, the Virtual Commons and the Cultural Commons of LC for their collaborative active learning towards problem solving. They pass through the PBL method in their coursework and get assigned problems to solve. They come to the LC and use its services and resources with their group mates. It is a vibrant place of a library where users can learn through inquiry, collaboration, discussion, knowledge sharing and consultation with their peers. Questions (Q24, Q25 & Q26) were asked to the learners as to how they are using the LC for learning. A big portion (84%) of the respondents has strongly agreed that they use LC services, resources and spaces for learning and knowledge sharing and acquisition (agree somewhat 38.4%, agree 37.5%, strongly agree 8.6%) and its mean score is 5.34 and standard deviation is 0.769 (Table 4.12). Respondents were asked (Q24) about the use of LC computer devices, designated spaces and library collection during learning. Almost 80% of them have positively agreed that they use those Physical Commons services and resources during learning for solving their course studies problems (mean score 5.29, standard deviation 1.02). In another

question (Q25) it was tried to understand the intensity of use of Virtual Commons in learning. 85.7% of the respondents have clearly

Table 4.12 LC use for learning in problem conclusion (PC)

Question	Strongly disagree	Disagree	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree	Strongly agree	Cumulative Percent	Mean	SD
Q24: We use LC computer devices, designated space and library collection during learning.	0.0	1.9	1.0	17.1	36.2	34.3	9.5	Disagree 2.9 Agree 80.0	5.29	1.02
Q25: LC portals, digital library collections, e-learning tools, productivity software helps us to prepare the solution.	0.0	0.0	3.8	10.5	37.1	42.9	5.7	Disagree 3.8 Agree 85.7	5.36	0.89
Q26: LC social resources like workshops, tutoring programs, research collaborations and coaching helps to generate new idea and create solution.	0.0	0.0	3.8	8.6	41.9	35.2	10.5	Disagree 3.8 Agree 87.6	5.40	0.93
Valid Percent	**0.0**	**1.9**	**2.9**	**12.1**	**38.4**	**37.5**	**8.6**			
Cumulative Percent		**4.0**		**12.0**		**84.0**				

Note: Cumulate Percent: Disagree = Sum of Strongly disagree + Disagree + Disagree somewhat and Agree = Sum of Agree somewhat + Agree + Strongly agree.

agreed that they use LC portals, digital library collections, e-learning tools, productivity software, etc. to prepare the solution (mean score 5.36, standard deviation 0.89). Last of all, users were asked (Q26) about the use of Cultural Commons services and social resources like workshops, tutoring programs, research collaborations, coaching, etc. for coursework problem solutions. 87.6% of the users gave a positive opinion that use of

those services and resources helps them to generate new ideas and create solutions (mean score 5.40, standard deviation 0.93).

RQ2: To what extent knowledge sharing and acquisition support users to identify learning problems, formulate inquiry, solution creation and problem conclusion in learning?

Knowledge sharing and acquisition has been identified as a mediating construct of the study which proves a positive connection with the respondents in identifying their learning problems, formulate inquiry, solution creation and problem conclusion (*H6, H7, H8, H9*). Evidence and practice of knowledge sharing of the users during learning are presented here. In seeking the link of knowledge sharing and acquisition with the phases of problem-based learning (PBL) several questions (KSA1, KSA2, KSA3, & KSA4) were asked to the respondents. Most of the participants (77.5%) perceived that knowledge sharing and acquisition has a positive influence on them for overall learning at LC. The mean response for knowledge sharing and acquisition was 5.37 with a standard deviation of 0.932 (Table 4.13). Of the respondents, 75% have agreed that (*Q20*) they discuss collected knowledge of the problem topics to understand new findings of the matter (mean score 5.18, standard deviation 1.34). Q21 asked them how discussion and knowledge sharing help in learning. Among them 85% have given the opinion that it helps them to innovate new ideas on the way to problem identification, formulate inquiry, solution creation and problem conclusion (mean score 5.81, standard deviation 1.24). The Q22 has tried to understand their perception of group discussion with knowledge acquisition, 82% of them have given a positive opinion that it helps them to integrate the collected knowledge with their current information and knowledge base (mean score 5.41, standard deviation 1.14). They have been asked (*Q23*) how writing results (knowledge acquisition) helps them on the way to problem conclusion and 72% of respondents replied that preparation of solution assist them to combine new knowledge with the old one and they can generate new concepts for concluding the problems (mean score 5.10, standard deviation 1.23).

Table 4.13 Knowledge sharing and acquisition (KSA) support problem identification (PI), formulate inquiry (FI), solution creation (SC) and problem conclusion (PC)

Question	Strongly disagree	Disagree	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree	Strongly agree	Cumulative Percent	Mean	SD
Q20: We discuss about collected knowledge to understand new findings.	0.0	5.7	6.7	12.4	28.6	32.4	14.3	Disagree 12.4 Agree 75	5.18	1.34
Q21: Discussion and sharing idea and knowledge help me to innovate new ideas.	0.0	1.9	4.8	7.6	16.2	35.2	34.3	Disagree 6.7 Agree 85	5.81	1.24
Q22: In group discussion we integrate the collected knowledge.	0.0	1.9	3.8	12.4	31.4	34.3	16.2	Disagree 5.7 Agree 82.0	5.41	1.14
Q23: By writing results we combine knowledge and develop new concepts with old one.	0.0	2.9	7.6	18.1	31.4	28.6	11.4	Disagree 10.5 Agree 72.0	5.10	1.23
Valid Percent	**0.0**	**3.1**	**6.8**	**12.0**	**26.9**	**32.0**	**19.0**			
Cumulative Percent		**9.9**		**12.6**		**77.5**				

Note: Cumulate Percent: Disagree = Sum of Strongly disagree + Disagree + Disagree somewhat and Agree = Sum of Agree somewhat + Agree + Strongly agree.

RQ3: How do LC users learning problem identification practice encourage them to learn and formulate inquiry?

LC has been regarded as a potential service system for the academic libraries. It has introduced a unique learning environment for library users in academia. To find out the use of Problem Based Learning (PBL) methods by the LC users, the researchers investigated the users with a questionnaire. Thus, the users were asked several questions (PI1, PI2, PI3, PI4, & PI5) on their problem identification practice of semester course studies with groupmates during learning at LC (*H10*). As shown in Table 4.14 that

Problem Identification (PI) has a mean score of 5.337 and standard deviation is 0.893 (on a seven-point Likert scale) and demonstrated 78% of high dependency of its practice by the users. Respondents of the questionnaire were asked (Q1) do they think that LC gives them the opportunity to work for solving learning problems with group mates outside of the classroom. 78.1% of the respondents have evidently agreed that LC is a great

Table 4.14 Problem Identification (PI) encourage Formulate Inquiry (FI)

Question	Strongly disagree	Disagree	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree	Strongly agree	Cumulative Percent	Mean	SD
Q1: Outside of classroom LC gives me the opportunity to work for solving learning problems with groupmates.	0.0	4.8	6.7	10.5	22.9	38.1	17.1	Disagree 11.4 Agree 78.1	5.34	1.329
Q2: Here we determine the driving question that we need to answer for solving the problem.	0.0	2.9	7.6	10.5	25.7	37.1	16.2	Disagree 10.5 Agree 79.0	5.35	1.256
Q3: Group learning help me to understand the broad nature of the problem.	1.0	2.9	7.6	11.4	27.6	36.2	13.3	Disagree 11.4 Agree 77.1	5.24	1.297
Q4: LC learning helps me to organize ideas by gathering previous knowledge.	0.0	2.9	7.6	10.5	25.7	37.1	16.2	Disagree 10.5 Agree 79.0	5.35	1.256
Q5: Learning in LC is improving my problem solving skills.	0.0	1.9	8.6	9.5	24.8	38.1	17.1	Disagree 10.5 Agree 80.0	5.40	1.237
Valid Percent	**0.95**	**3.1**	**7.6**	**10.4**	**25.0**	**37.0**	**16.0**			
Cumulative Percent		**11.6**		**10.4**		**78.0**				

Note: Cumulate Percent: Disagree = Sum of Strongly disagree + Disagree + Disagree somewhat and Agree = Sum of Agree somewhat + Agree + Strongly agree.

opportunity for them to work outside of the classroom (mean score 5.34, standard deviation 1.33). It is found 79% of them clearly agreed that (Q2) here they can determine the driving questions that need to be answered for solving course assigned problems (mean score 5.35, standard deviation 1.26). Respondents were asked also (Q3) about the influence of group learning on problem identification (mean score 5.24, standard deviation 1.30). It shows that 77.1% of the respondents gave a strong opinion that group learning assists them to understand the learning problem. It emerged that about 79% of the respondents have agreed (Q4) learning with group mates at LC helps them to organize ideas by gathering course related previous knowledge (mean score 5.35, standard deviation 1.26). However, by combining agree somewhat (24.8%), agree (38.1%) and strongly agree (17.1%), a total of 80% respondents has strongly agreed that (Q5) collaborative learning opportunity at LC is continuously improving their problem solving skills (mean score 5.40, standard deviation 1.24).

RQ4: How does formulate inquiry motivate learners in solution creation of learning problems?

Formulate inquiry assists the users to identify the topics that they need to know for solving problems. During LC learning some questions arise to learners that need to be answered on the way to solve the problem. The questionnaire asked questions (FI1, FI2, FI3, FI4 & FI5) to find out how formulate inquiry stimulated them for solution creation (*H4*). About 79% of the respondents have agreed (agree somewhat 25.71%, agree 38.28%, strongly agree 15.80%) that formulating inquiry inspires them for solution creation and its mean score was 5.36 and standard deviation was 0.921 (Table 4.15). Participants were asked (*Q6*) do they need to know answers of questions and unknown issues that arise during learning in groups at LC. In this issue 82% users showed a positive response that they need to search for answers for their unsolved questions and topics (mean score 5.42, standard deviation 1.20). When answering the question Q7 about 76% of respondents have agreed that they can realize what information is needed to know further for creating the tentative solution (mean score 5.23, standard deviation 1.38). They were asked questions Q8, Q9 and Q10 with an intention to know the respondent`s behavior for locating and sharing their needed information. Most of them (80%) have expressed that they (*Q8*) plan to take help from the experts regarding to locate information and try to

search information by themselves (mean 5.35, SD 1.30). 79% of the respondents have conveyed that (*Q9*) they share and explain ideas with learning mates which helps them to formulate new inquiry

Table 4.15 Formulate inquiry (FI) motivates in solution creation (SC)

Question	Strongly disagree	Disagree	Disagree somewhat	Neither disagree not agree	Agree somewhat	Agree	Strongly agree	Cumulative Percent	Mean	SD
Q6: In LC group work several questions and unknown issues arise that we need to know	0.0	1.9	7.6	8.6	26.7	39.0	16.2	Disagree 9.5 Agree 82.0	5.42	1.2
Q7: I can understand what information we need to know further	1.0	3.8	9.5	9.5	24.8	36.2	15.2	Disagree 14.3 Agree 76.2	5.23	1.38
Q8: We plan to take help from experts and search information.	1.0	2.9	6.7	9.5	25.7	38.1	16.2	Disagree 10.5 Agree 80.0	5.35	1.30
Q9: Here I share and explain my ideas	0.0	2.9	7.6	10.5	24.8	39.0	15.2	Disagree 10.5 Agree 79.0	5.35	1.25
Q10: Group mates teaches each other about the new findings	0.0	1.9	6.7	9.5	26.7	39.0	16.2	Disagree 8.6 Agree 81.9	5.43	1.19
Valid Percent	**0.95**	**2.6**	**7.6**	**9.5**	**25.7**	**38.2**	**15.8**			
Cumulative Percent		**12.0**		**9.0**		**79.0**				

Note: Cumulate Percent: Disagree = Sum of Strongly disagree + Disagree + Disagree somewhat and Agree = Sum of Agree somewhat + Agree + Strongly agree.

on the way to create solutions (mean score 5.35, standard deviation 1.25). Moreover, this research reveals a unique behavior of the respondent when they were preparing candidate solutions to the problems. In response to the question Q10, remarkably 81.9% of the users agreed that they taught each other about the new findings during inquiry formulation. This teaching is nothing but peer learning practices of the users which is believed to be continued as a lifelong learning behavior in their future endeavor (mean score 5.43, standard deviation 1.19).

Here we found formulate inquiry to solution creation are very interactive phases of PBL as the users of LC work together with their group mates during learning. Throughout the group work they try to know answers to new questions and unsolved issues and take help from LC staff and experts for searching information and sharing new information with groupmates. They generate new ideas with discussion and propose candidate solutions of the problems that they have from their course of studies.

RQ5: How does solution creation positively direct learners for problem conclusion at LC?

In problem-based learning (PBL), learners try to create the tentative solutions of the problems which leads them to the final phase of problem conclusion where they submit their overall learning outcome. More than 73% of the respondents have agreed that (*H12*) the activities for solution creation (SC1, SC2, SC3, SC4 & SC5) definitely direct them towards the final stage of problem conclusion (mean score 5.27, standard deviation 0.972). About 71% of the respondents agreed that during LC learning (*Q11*) they can determine the topics which are important to know in the beginning (mean 5.18, SD 1.41). In response to the indirect question (*Q12*) what the activities are they do for solving the problems. More than 75% of the participants have given an overall agreed statement that they assign group or individual tasks like information collection, report writing, creating presentation, etc. for reaching a tentative solution of the problems (mean score 5.30, standard deviation 1.32). When the users were asked (*Q13*) about their main purpose of learning activities together with groupmates. Around 76% of them have positively agreed that here they work together for creating the best possible presentation or solution of the problem (mean 5.30, SD 1.33). Although there is some evidence of enhancement of problem-solving skills of the respondents which might persist in their professional life. 75% of the participants (*Q14*) have agreed that while working in LC they rehearse and review their tentative presentation or solution which makes them reach the final stage (mean 5.26, SD 1.36). Moreover, it is evident from responses that learners are integrating resources in their learning from LC services. In the question (*Q15*) how LC programs and facilities help in learning. More than 76% of the respondents have overall agreed that services and facilities arranged by LC (lecture seminar, events, writing support, academic support,

etc.) helps them to generate the best solution (mean score 5.35, standard deviation 1.30). It indicates that LC has a direct and positive contribution in learning of the users.

Table 4.16 Solution creation (SC) direct for problem conclusion (PC)

Question	Strongly disagree	Disagree	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree	Strongly agree	Cumulative Percent	Mean	SD
Q11: During LC learning I can determine which topic is important to know in the beginning.	1.0	1.9	13.3	12.4	21.9	32.4	17.1	Disagree 16.2 Agree 71.4	5.18	1.41
Q12: We assign group or individual tasks like information collection, report writing, creating presentation, etc. for solving the problems.	0.0	2.9	9.5	12.4	23.8	33.3	18.1	Disagree 12.4 Agree 75.2	5.30	1.32
Q13: We work to create the best possible presentation or solution of the problem.	0.0	2.9	10.5	10.5	24.8	33.3	18.1	Disagree 13.3 Agree 76.2	5.30	1.33
Q14: While working in LC we rehearsal and revision our tentative presentation or solution.	0.0	3.8	10.5	10.5	23.8	34.3	17.1	Disagree 14.3 Agree 75.2	5.26	1.36
Q15: LC programs (J-Beans lecture seminars, events) helps me to generate the best solution.	0.0	1.9	9.5	12.4	23.8	32.4	20.0	Disagree 11.4 Agree 76.2	5.35	1.30
Valid Percent	**0.9**	**2.7**	**12.2**	**11.6**	**22.6**	**33.4**	**17.6**			
Cumulative Percent		**14.8**		**11.6**		**73.6**				

Note: Cumulate Percent: Disagree = Sum of Strongly disagree + Disagree + Disagree somewhat and Agree = Sum of Agree somewhat + Agree + Strongly agree.

RQ6: How do problem conclusion solve problems and complete user learning at LC.

Problem conclusion is the last phase of PBL for reaching the final stage of solution. Here the user summarizes and combines their knowledge, practice and revise the output of the assigned course problems and move forward with the final solution. A total of 75% of the

Table 4.17 Problem conclusion solve and complete user learning at LC

Question	Strongly disagree	Disagree	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree	Strongly agree	Cumulative Percent	Mean	SD
Q16: Through discussion we summarize relevant knowledge and identify what is needed to know more.	0.0	4.8	2.9	14.3	28.6	35.2	14.3	Disagree 7.6 Agree 78.1	5.30	1.24
Q17: Through practice and preparation we try to decide the best ways for solution.	0.0	1.0	10.5	8.6	22.9	40.0	17.1	Disagree 11.4 Agree 80.0	5.42	1.23
Q18: Based on group feedback we revise the presentation and evaluate its' accuracy.	0.0	2.9	5.7	16.2	31.4	26.7	17.1	Disagree 8.6 Agree 75.2	5.25	1.25
Q19: While preparing the final solution we still find some unanswered issues.	1.0	3.8	5.7	19.0	29.5	28.6	12.4	Disagree 10.5 Agree 70.5	5.08	1.31
Valid Percent	**0.5**	**3.0**	**7.0**	**14.5**	**28.0**	**32.5**	**14.5**			
Cumulative Percent		**10.5**		**14.5**		**75.0**				

Note: Cumulate Percent: Disagree = Sum of Strongly disagree + Disagree + Disagree somewhat and Agree = Sum of Agree somewhat + Agree + Strongly agree.

respondents have agreed that in the problem conclusion phase they prepare the final presentation or solution for best conclusion (mean score 5.26, standard deviation 0.944). About 78% of the respondents have exhibited a positive response that (*Q16*) through discussion they can summarize relevant knowledge and identify what is needed to know more for solving the problem. In PBL group learning, while the learners prepare the final

solution, practice helps them to move forward. When they were asked to know about the matter (*Q17*), 80% of the respondents gave a positive response that they try to decide the best ways for a solution on the basis of practice and preparation during group work (mean score 5.42, standard deviation 1.23). In response to the indirect question (*Q18*) on how they judge the accuracy of the solution. More than 75% of the participants have overall agreed (agree somewhat 31.4%, agree 26.7%, strongly agree 17.1%) that based on group feedback they revise the presentation and evaluate its accuracy (mean score 5.25, standard deviation 1.25). Moreover, 70.5% of the learners has (*Q19*) confidently answered that while preparing the final solution they find some unanswered issues which they solve before submission with the help of LC tutoring staff as well as course teachers (mean score 5.08, standard deviation 1.31).

4.8.1 Summary of Findings

The study conducted an online survey which lasted for two months and included bachelor, master, doctoral, certificate course and special auditor students. The survey led to deep analysis of LC use of the JAIST, Kanazawa University and Nagoya University library and results are summaries from the agreed opinion of the users in percentage.

The findings that have emerged as a result of the research questions delineates a high dependency of the users on LC services and existence of problem-based learning (PBL) technique in users` learning. RQ1 show that users are using physical commons, the virtual

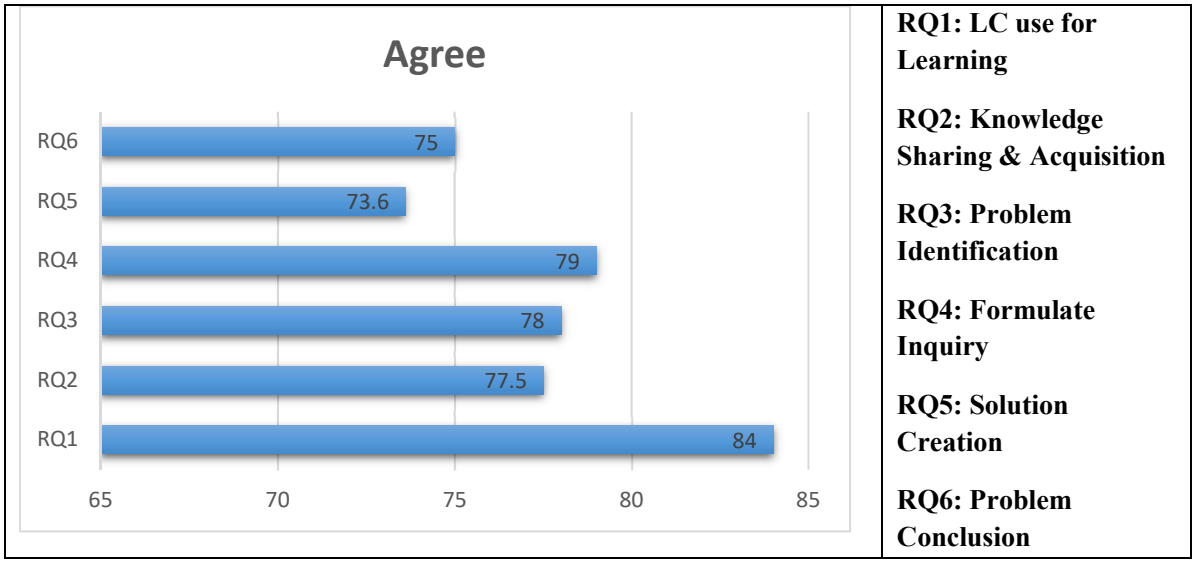

Figure 4.3 Summary of findings

commons and the cultural commons for their collaborative learning towards problem solving (84%). RQ2 confirms that users are playing a knowledge transformer role during their group process of learning in LC spaces. They are sharing and acquisitioning new knowledge in their earlier knowledge base and completing learning (77.5%). For the evidence of existence of problem-based learning in out of class spaces of LC, the RQ3 confirm that users identify their learning problems during group or informal learning (78%). RQ4 also indorse that LC users formulate inquiry towards their learning problems solving process (79%). Users have agreed that learning at LC spaces in RQ5 helps them to create the tentative solution (73.6%). In RQ6, users have expressed that they reach the conclusion of the learning problems during out of class LC learning (75%).

4.9 Conclusion

Analyzing the findings of the questionnaire the study found that LC has given the opportunity to the learners to work in groups for solving their course study problems. After the problems assigned in their coursework, learners come to the library and use LC as one of the pioneer vibrant learning spaces in the campus. It is a unique space for them to interact with their learning mates in an out of class environment. Learners appear here for solving the problems absentmindedly bearing the problem-based learning (PBL) method in their mind. During their learning they try to identify the actual problem that has been assigned by the course teachers. For solving the problems, they proceed to formulate inquiry, solution creation and problem conclusion phases of PBL. Thus, the study shows that LC supports the PBL method of learning outside of class space. So, the libraries need to provide sufficient orientation to their LC staff about learning methods. Apart from that the knowledge sharing and acquisition culture of the users are found as an inseparable part of group learning at LC. It shows that knowledge sharing and acquisition helps the learners to generate new ideas and reach a conclusion with a suitable solution. Therefore, LC needs to give more attention in this part and arrange its spaces and services for the proliferation of this behavior of the users. The study also found that LC is a super hub for the learners for its spaces, services, and resources. It shows that they use the services and resources for solving the learning problems. They take help from the LC staff and use resources to integrate knowledge in their earlier ideas and rehearse the tentative solution. Thus, it is high time for LC to rethink their continuum of services and resources. They need to arrange the services and resources bearing the PBL learning

method and knowledge sharing and acquisition culture in their mind and ensure the best continuum of services for the learners. LC has created a new learning pedagogy by integrating the PBL method, knowledge sharing and acquisition culture and its continuum of services. It is the user-centered learning (UCL) pedagogy of LC in academia.

Chapter 5: Conclusion and Implications

5.1 Introduction

This chapter presents the summary of the current research general findings and as well as highlights the study's key findings in order to offer responses to the research questions. The study was mostly descriptive and exploratory in nature, with the goal of identifying a significant causal relationship of PBL and LC learning and problem-solving practice. In the previous chapter data presented and interpreted to investigate LC user for learning (user centered learning), knowledge sharing and acquisition as transformative behavior of LC learners for new PBL phased in LC and support of PBL process learning at LC. Then it proposed a theoretical model for supporting user centered PBL learning at LC followed by implication, limitations and directions for future research.

5.2 Answer to the Research Questions

SRQ1: How do LC continuum of services are used for user-centered (self-responsible) learning?

In the beginning the present study has perceived the LC use for users self-responsible learning. The importance of learning in academic libraries were considered very importantly and they have redefined their spaces for introducing collaborative learning among the users. Academic libraries are attempting to transform themselves into social, cultural, and technical hubs by upgrading their physical facilities to accommodate a variety of user groups who may collaborate with digital and print material (Sinclair, 2009). They have introduced Learning Commons (LC) to engage the learners groups so that they can use this space for their own self-learning. LC continuum of service includes the physical commons, virtual commons and cultural commons which is a logical division of its services. The first one Physical Commons consists of the computer hardware, furnishings, designated spaces, and traditional library collections (Beagle, 2006, p. 8). The second level, the Virtual Commons, contains the Web environments (portals, websites, etc.), digital library collections, e-learning tools, and online tools (search

engines, productivity software, etc.) of the library. The third level, the Cultural Commons, is made up of social resources like workshops, tutoring programs, research collaborations, coaching, and so on, that takes place as a result of the group environment created through the Commons (Beagle, 2006, p. 8). Social, cultural, and political envelope of cultural commons supports and extends the physical commons and virtual commons, and these are the enabler for learning in LC (Beagle, 2006, p. 5).

LC is a space where new ways of learning are happening. As an informal learning space, LC has introduced an emerging learning pedagogy by collaborating multiple support units and tutoring and learning services. A LC must be able to accommodate students' constantly changing learning activities, rather than information-management duties set and taught by library or faculty (Bennett, 2003). It is highly accepted that user students engage cooperatively with their group mates in LC areas to pursue their self-directed learning. They have a lot of freedom in terms of choosing their own topic and methods, and they are in charge of their own learning objectives. So, at LC, student-centered learning is nothing more than library user-centered learning (UCL). It is a new kind of learning pedagogy in academia based on self-responsible learning of the LC users. Here they complete the PBL phases of problem identification, formulate inquiry, knowledge sharing and acquisition, solution creation and problem conclusion for solving the learning issues.

In summary, the main uses of LC for user-centered learning can be summarized as;

Use of Physical Commons for learning

Learners have confirmed that they use physical common, the first continuum of services of LC. Survey analysis in the previous chapter provides the opinion that users use LC computer devices, designated spaces, and library collection during learning (Mean 5.29, SD 1.02).

Use of Virtual Commons for learning

LC users can directly access the virtual commons services of LC and they use it strongly for their learning and research purposes. When trying to understand the intensity of use of virtual commons in learning, users have clearly agreed that they use LC portals, digital

library collections, e-learning tools, productivity software, etc. for learning (Mean 5.36, SD 0.89).

Use of Cultural Commons for learning

This entails that the user uses the cultural commons continuum instantly for their learning. They expressed strong opinions about their usage of cultural commons services and social resources for coursework issue solving, such as workshops, tutoring programs, research partnerships, coaching, and so on. Using those services and tools helps them come up with new ideas and solve problems (Mean 5.40, SD 0.93).

The findings lead to the conclusion that user students use LCs` continuum of services for their self-responsible own learning and it is the unique user-centered learning (UCL) or self-responsible learning of the users in out of class spaces.

SRQ2: How does learners` transformer role in group learning knowledge sharing and acquisition at LC solve learning problems?

User students were asked these questions on the basis of the problem-based learning cycle phases mainly based on the Hmelo-Silver (2004); Mohd-Yusof, Helmi, Jamaludin, and Harun (2011); and English and Kitsantas, (2013). Libraries are now in a paradigm shift from information resources-centric view to user-centric approach and learning is in the heart of that approach. Academic libraries have introduced learning commons to meet the diversified learning and research needs of the TechieGen user. LC is a collaborative learning space where students come to solve their course studies problems. Constructivist theory based PBL learning enhances effective learning at LC. In LC collaborative learning, users actively construct knowledge by acquisitioning knowledge to their early knowledge base as they interpret new information that they have already collected (Loyens & Gijbels, 2008). During the group learning process of LC, learners create knowledge and share it with their peers in order to generate new ideas and solve issues.

Apart from that LC is an out of class environment for the learners where they can engage in active learning for completing their PBL process. Students construct questions based on self-identified knowledge gaps, which they use to guide independent study outside of the classroom, with research tasks allocated among team members (Allen, Donham, & Bernhardt, 2011). Students gather knowledge and share and acquire it among themselves

as part of their learning process in order to create new knowledge and address learning problems. In the problem-solving process, students are creating new information and sharing and acquiring knowledge through cooperative learning. As a result, in the out of class space that LC has established, the students themselves are acting as knowledge transformers among the peers in the absence of their teachers.

Knowledge transformer role of LC learners is now quite clear in the regular PBL cycle phase, and it looks a new phenomenon in LCs` out of class learning activity. Therefore, taking the transformer role of users for knowledge sharing and acquisition into consideration the study has extended the PBL cycle phase for LC. This finding supports Hmelo-Silver (2004) opinion of ``at the completion of each problem, students reflect on the abstract knowledge gained``. However, the results support the opinion of the PBL experts of its cycle phases and it can be summarized from the survey respondents:

Discuss about collected knowledge to understand new findings (problem identification)

Users have agreed that they discuss collected knowledge of the problem topics to understand new findings of the matter (Mean 5.18, SD 1.34).

Discussion and sharing idea and knowledge help to innovate new ideas (formulate inquiry)

It was asked how discussion and knowledge sharing helps in learning. Among them 85% have given the opinion that it helps them to innovate new ideas on the way to problem identification, formulate inquiry, solution creation and problem conclusion (Mean 5.81, SD 1.24).

Integrate collected knowledge during group discussion (solution creation)

This implies understanding the learner`s perception of group discussion with knowledge acquisition. They have given a positive opinion that it helps them to integrate the collected knowledge with their current information and knowledge base (Mean 5.41, SD 1.14).

Combine knowledge and develop new concepts by writing results (problem conclusion)

When asked how writing outcomes (knowledge acquisition) helps them in the problem solution they strongly said that solution preparation helps them mix new information with

the existing knowledge and produce new thoughts for solving problems (Mean 5.10, SD 1.23).

Finally, the summary of this SRQ finds out that the users` transformative behavior for knowledge sharing and acquisition is an inseparable phase of PBL process learning in LC.

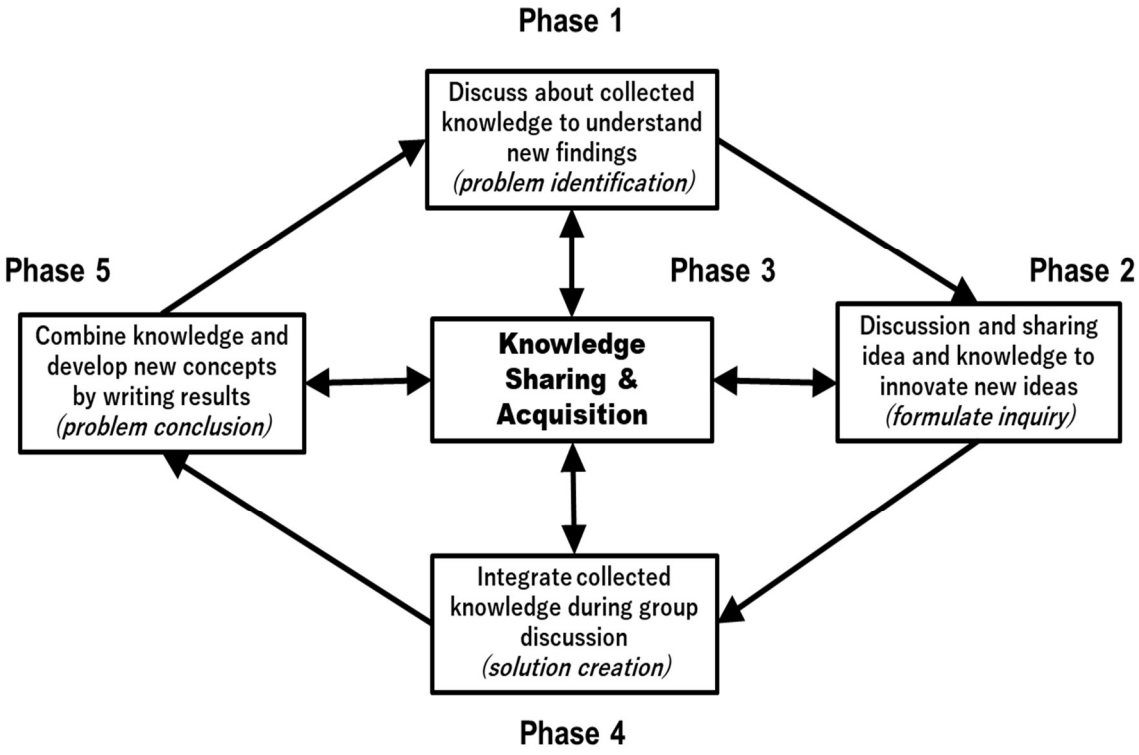

Figure 5.1 Knowledge Sharing & Acquisition as PBL Phase in Learning Commons

The finding supports the PBL cycle phases of Hmelo-Silver (2004) where she identified `Knowledge Deficiencies` and `Apply New Knowledge` as the steps of the process. So, it determines that `Knowledge Sharing and Acquisition` behavior of LC users is a confirmed phase of the PBL cycle phase of LC.

SRQ3: How does problem-based learning (PBL) phases support out of class informal learning at LC?

Learning commons has created out of class spaces for the students for pursuing their PBL activities of learning. Its collaborative spaces encourage the learners to work with group mates for solving their coursework problems. It is a kind of library service in which

librarians, commons staff, technical staff, and student tutoring staff collaborate and interact with users for their assignments, research, writing, technical support, information literacy program, faculty development, curricula development and some other things. This type of opportunity creates an informal learning space for the learners (Lippincott, 2006). To help people learn in this area, LC develops group study rooms, cafés, exhibition places, a digital lab, a tutor zone, and digital resources. It provides a chance for informal learning in an out-of-class setting where students may work in groups to solve challenges related to their course topics.

In the PBL process learners start their learning with ill-structured problems as assigned by their teachers in the courses. Students pursue their learning here without direct supervision of the course teachers. So, it becomes an informal learning within the PBL process and students continue to study in LC to complete the PBL cycle phases for solving learning problems. Problem identification is the first phase where user students try to identify the driving questions of the problem posed (Mergendoller, Maxwell & Bellisimo, 2006). Then gradually they complete the formulate inquiry, solution creation and problem conclusion phase to reach the solution of their coursework problems. LC informal learning space supports the PBL activities.

The purpose of this research question was to empirically examine how LC informal learning spaces support PBL process learning in academia. We have analyzed the responses of the survey and found strong evidence of PBL phased in LC. Knowledge sharing and acquisition role of the users was not checked here as it was confirmed in the earlier. Evidence of PBL in LC can be summarized as;

Problem Identification

In determining the evidence of Problem Based Learning (PBL) approaches of LC users learning, they were asked questions for problem-solving skills in semester course studies. They think that LC gives them the opportunity to work for solving learning problems outside of the classroom. They can determine the driving questions that need to be answered for solving course assigned problems (Mean 5.35, SD 1.26). Moreover, they gave a strong opinion that group learning assists them to understand the learning problems. Learning opportunities with group members at LC helps learners to organize ideas by gathering course related previous knowledge. However, respondents have strongly agreed

that collaborative learning opportunities at LC are continuously improving their problem solving skills (Mean 5.40, SD 1.24). Thus, the learners identify their learning problems within the group learning process of LC.

Formulate Inquiry

After identifying the problems that the learners need to solve, they proceed to the formulate inquiry phase of the PBL process. Here they try to identify the topics that are needed to know for answering the problems. In this process some questions arise to the learners that need to be answered on the way to reach the final answer. Regarding the issue, users showed a positive response that they need to know answers to questions and unknown issues that arise during learning in groups at LC (Mean 5.42, SD 1.20). 76% of the learners have agreed that they can realize what information is needed to know further to reach the answer. They were asked questions with an intention to know their behavior for locating and sharing needed information. Most of them (80%) have expressed that they plan to take help from the LC staff or experts to locate information and try to search information by themselves (Mean 5.35, SD 1.30). The learners have conveyed that they share and explain ideas with group mates which helps them to formulate new inquiry (Mean score 5.35, SD 1.25). Moreover, this research reveals a unique behavior of the respondent when they were preparing candidate solutions to the problems. 81.9% of the users agreed that they teach each other about the new findings during inquiry formulation. This teaching is nothing but peer learning practices of the users which is believed to be continued as a lifelong learning behavior in their future endeavors (Mean 5.43, SD 1.19). In this way learners generate new ideas with discussion and propose candidate solutions of the problems that they have from their course of studies.

Solution Creation

The target of PBL learners is to reach the tentative solution of the learning issues. They strongly agreed that the collaborative learning opportunity at LC helps them to create the candidate solution by combining their collected knowledge. Learners expressed that they assign group or individual tasks like information collection, report writing, creating presentation, etc. for reaching a tentative solution of the problems (Mean 5.30, SD 1.32). When they were asked about the main purpose of collaborative learning together with

groupmates, they confirmed that they would work together for creating the best possible presentation or solution of the problem (Mean 5.30, SD 1.33). Although it was evident from them that collaborative work enhances their problem solving skills which they think might persist in professional life. 75 percent of the users have agreed that while working in LC they rehearse and review the tentative presentation or solution which makes them reach the final stage. Moreover, it is evident that LC programs and facilities help them in learning, and they integrate resources from its services. More than 76% of the respondents have overall agreed that services and facilities arranged by LC (lecture seminar, events, writing support, academic support, etc.) helps them to create the best possible solution. It indicates that LC has a direct and positive contribution in the solution creation process of the users.

Problem Conclusion

The last phase of PBL is problem conclusion, which leads to the ultimate stage of final solution. Here, the user consolidates and integrates their knowledge, as well as practice and revise the output of the assigned course tasks before moving on to the final answer. In this phase they prepare the final presentation or solution for the best conclusion of the learning issues. When knowing the LCs` role for problem conclusion, about 78 percent of the users said through conversation they could summarize important knowledge and determine what they needed to know more to solve the problem. Most of the users gave a positive response that they try to decide the best ways for a solution on the basis of practice and preparation during group work. More than 75 percent of the users have agreed that based on group feedback they revise the presentation and evaluate its accuracy. Furthermore, students have firmly said that when preparing the final solution, they encounter certain unsolved challenges that they resolve before submitting the final solution (Mean 5.08, SD 1.31). Thus, the users complete their PBL cycle phases of informal learning at LC and solve their course work learning issues in an out of class environment.

5.3 Answer to the Major Research Question

MRQ: How do learning commons (LC) is constructing problem-based learning (PBL) supported user-centered learning (UCL) in academic libraries?

The major research question (MRQ) is addressed in this chapter as part of a series of three subsidiary research questions (SRQ) targeted at identifying the evidence of user-centered problem-based learning (PBL) for the first time at learning commons in academic libraries. The summary of the three SRQs that have been addressed through the data supplied in Chapters 4 to this research topic. We have produced subsidiary research questions, literature review components, and some background of this study to address the research problem.

The research concentrated on learning at learning commons (LC), with a particular focus on user learning and PBL phases. Academic libraries are now in a paradigm shift to manage the Techie Gen offered challenges due to new technological changes and learning activities. They are redesigning their spaces, services, collections and introducing LC for user learning. Beagle (2012) has indicated the faculty interest about constructivist learning which can connect LC due to its informal learning spaces. Brown (2005) has affirmed that LC supports PBL process learning in its out of class environment as the learners collaborate to engage in active learning. LC has been introduced to engage the learner groups so that they may utilize this place for their self-learning. The physical commons, virtual commons, and cultural commons are all part of the LC service continuum, which is a logical split of its services. LC learning is student-centered or user-centered where they come by themselves for pursuing their out of class learning activities. In user-centered learning students take much responsibility for their own learning. They are consuming the continuum of services as per their learning requirements and sufficient literary evidence is not available that libraries are checking their usability regularly. Academic libraries need to pay attention to this, and they need to offer special programs to motivate users to come and use the space for regular learning. They should have to check the usability of its continuum of services and collect feedback from the users on a regular basis so that the services can meet the learning needs. User-centered learning (UCL) is a shift in learning theory in which LC staff need to generate ideas from the self-regulated and self-directed learning theories and must try to achieve LC goals.

The learning commons (LC) is a collaborative learning place where students can meet to tackle challenges related to their course study. PBL learning based on constructivist philosophy improves learning at LC. The present study has focused on the transformer role of the user for knowledge sharing and acquisition in learning. It is evident from the results that users are creating new meaning (knowledge) and acquiring and sharing knowledge in the LC group learning process in absence of their course teachers outside of class. LC group learning process has confirmed the learners to play the role of knowledge transformer during collaboration. It is quite a new phenomenon for PBL phases in LC.

This study aims to show that users` knowledge sharing and acquisition during group learning is a confirmed PBL phase of LC. So, it needs to give importance to enhance group learning activities of the users. LC can redesign its spaces to engage them in groups and encourage discussion and idea generation. A lively library seeks to arouse interest in group learning via inquiry, cooperation, conversation, and consultation (McMullen, 2008). Taking knowledge sharing and acquisition as a confirmed PBL phase in LC, they have to enhance skills of the LC tutoring staff in the group learning process. An increased skill of staff will encourage the learners to engage in group learning and learners will be able to discuss to understand new findings, share ideas and knowledge to innovate new ideas, integrate collected knowledge during discussion and combine knowledge to create the best possible solutions of their learning issues. It will encourage the learners for the group process of learning, and they will become independent learners in an out of class environment.

LC fosters PBL supported informal learning environments in which common tutoring staff and users collaborate to identify user requirements. In PBL process learners are assigned ill-structured learning problems from their course work. Learners come to this space for their out of class informal learning to work with their group mates. LC is a library service where librarians, commons staff, technical staff, and student tutoring staff collaborate and interact with users for their assignments, research, writing, technical support, information literacy program and so on. In the group process of collaborative learning users complete the PBL cycle phases to reach the solution of their learning problems. This research has evidenced that the informal learning at LC is primarily based on the PBL method.

Therefore, LC needs to understand the learning methods of user learners in its spaces. Learners of this space are completing their tasks bearing the PBL method in their mind. Commons and tutoring staff need to keep it remembered for arranging all of their offerings according to its phases. It needs to redefine their role to better serve with the PBL process learning. They need a deep understanding of the PBL method as well as complete ideas about its cycle phases. They have to help users to determine the specific learning issues, what they need to know more about the subject topics, combine their understanding for preparing the tentative solutions and help them to practice and trial the final solution. It will stimulate the user learners to go to these spaces for informal out of class PBL learning. Surely learning commons will become a super hub for learning in academia.

The overall findings of the investigation are summarized in Figure 5.2.

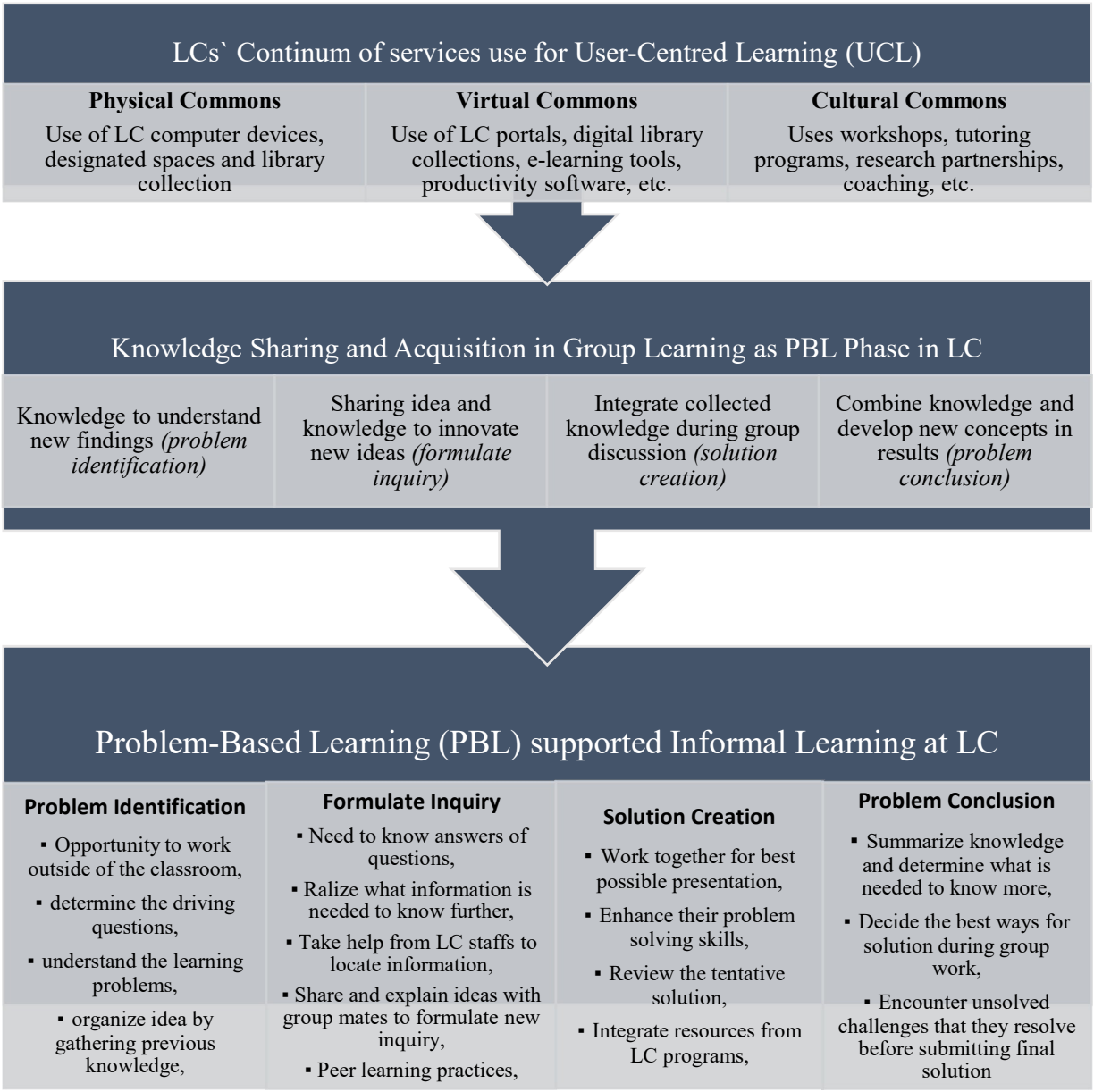

Figure 5.2 Characteristics of PBL supported User-Centered Learning (UCL) at LC

5.4 Theoretical Model

This dissertation makes a significant contribution by proposing a theoretical model of user-centered learning (UCL) at learning commons (LC) of academic libraries. We suggest the following model for our study based on the literature review, the research questions, and data from prior chapters we have undertaken, and the hypothesis we developed (see Figure 5.3). The model has taken into consideration the three key constructs of the study - LC use for learning, knowledge sharing and acquisition and

problem-based learning (PBL) for out of class user learning at LC. The model should be seen from left to right and then downwards.

Libraries and learning are inseparable and for long academic libraries are in charge of learning in academia. For the learning of the learners libraries develop numerous relationships with them by offering time buffeting services and resources. But recent studies determine that technology and user expectation are reshaping the services of academic libraries (Allen, Mullins, & Hufford, 2007). Academic library users of this age are very technology dependent and Internet skilled for their information and learning needs. So these library users are determined as `Techie Generation` (TechieGen) users. Due to technological advancements and evolving leaning demand of the users, libraries are facing challenges like shift to digitization and budget constraints, alternative body of library, diminishing user numbers, decline in circulation and lower seat occupancy (Akeroyd, 2001; Johnson & Lilly, 2012). These TechieGen users want to seek information on their own and expect to have more access to digital resources, online services, and interactive places for their learning (Thomas & McDonald, 2005).

Libraries are trying to face those challenges by adopting technological changes and redesigning its spaces for introducing changes of user learning demand. They are introducing Learning Commons (LC) spaces for the best practice of out of class learning of its users in the library. But literary evidence shows that LC is not much aware about the learning behavior and learning methods of its users. This research has taken the chance for framing a theoretical model to introduce PBL based user-centered learning pedagogy at LC.

The group learning in LC of academic libraries is the focus of the second part of this model. Based on Beagle (1999) as LC is a collaborative learning space where group processes can modify knowledge in ways that reflect the large-scale growth of knowledge in the culture around us will be more beneficial to them, the study concentrated on users` knowledge sharing and acquisition transformer role in group learning (Hmelo-Silver, 2004). The finding of the study has already evidenced knowledge sharing and acquisition as a confirmed PBL phase for LC learning. LC is an interactive space where users are learning in groups through discussion, reflection, feedback, peer teaching, sharing and acquisition of thoughts and knowledge. But there are some barriers to the knowledge sharing of learners, including learning ability, sources knowledge, motivation and

transmission channels (Gupta & Govindarajan, 2000). Moreover, information technology and socialization of team members also influence knowledge sharing during

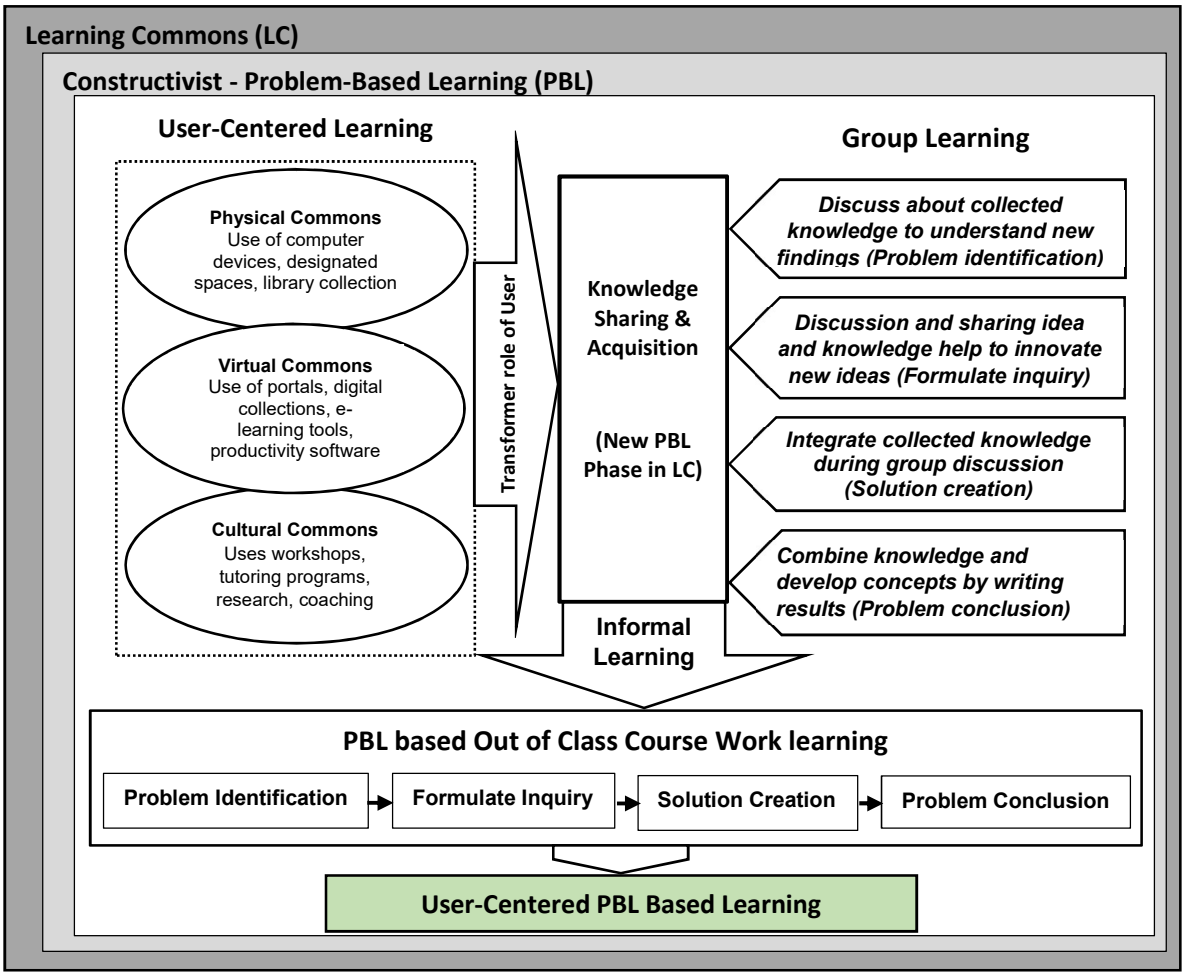

Figure 5.3 User-Centered PBL Based Learning Pedagogy at LC in Academic Libraries

learning (Lagerstrom & Andersson, 2003). LC needs to concentrate on group learning process of its collaborative spaces. Tutoring staffs needs to give emphasis to engage the users in groups so that they can engross in problem solving process based on the knowledge sharing and acquisition PBL phase of LC model.

The third part of the model in the down portion refers to informal learning in out of class LC environment. Its` social spaces and group study rooms support face to face encounter for informal learning (Beatty & White, 2005). LC promotes a PBL-supported informal learning environment in which users and commons tutoring staff cooperate to discover

user needs. Learners are handed ill-structured learning tasks from their course material in the PBL process. Learners use this place for informal learning outside of class and to collaborate with their peers. LC is a library service in which librarians, commons staff, technical staff, and student tutoring staff engage and interact with users on assignments, research, writing, technical help, and information literacy programs, among other things (Beagle, 2012). Users in the collaborative learning group process complete the PBL cycle phases to arrive at a solution to their learning problems. The survey findings in the previous chapter has already evident that the informal learning at LC is based on the PBL technique.

Earlier research indicates that learning activities of PBL are supported by LC which encourages users to engage in an out of class environment (Brown, 2005). But this study has identified some significant areas where this research shades light on those gaps. Librarians has designed LC spaces for facilitating informal learning without considering any learning method like PBL. LC needs to consider the informal learning methods of its user learners in out of class PBL environment. Librarians and LC tutoring staffs need to study the PBL method to better support in learning. They have to determine their learning support strategy according to the learning methods of the learners. Tutoring staffs need to support the PBL learners to identify their learning issues, understand how to formulate inquiry, create solution with practice and rehearsal and reach in problem conclusion. Those support for informal learning will make the PBL supported out of class LC spaces fruitful to its users.

According to the arguments presented in the model, the suggested approach may have an impact on user-centered learning at LC spaces. Its` paradigm has included problem-based learning phases, collaborative group learning, knowledge sharing and acquisition, and informal learning in out of class space. These elements are mapped together as they can accelerate to manage the changing needs of user learning in academic libraries. LC continuum of services must manage the technological changes in user self-responsible own learning. Collaborative group learning needed to accelerate knowledge sharing and acquisition for reaching in problem conclusion. PBL process informal learning confirms a strong support from the LC tutoring staffs to complete the out of class course work problem solving. Based on the elements of the present study, LC learning is user centered. Users are in the charge of their own learning and course work teachers, librarians and LC

tutoring staffs are the motivator to them in out of class environment. It is LC who has created this new user-centered learning (UCL) pedagogy in the academia.

5.5 Implications of the Research

From the originality point of view this research has evident that LC supports problem-based learning (PBL) method in it's out of class space. In PBL process learners start their learning with ill-structured problems as assigned by their teachers in the courses. Students pursue their learning here without direct supervision of the course teachers. So, it becomes an informal learning within the PBL process and students continue to study in LC to complete the PBL cycle phases for solving learning problems. Problem identification is the first phase where user students try to identify the driving questions of the problem posed (Mergendoller, Maxwell & Bellisimo, 2006). Then gradually they complete the formulate inquiry, solution creation and problem conclusion phase to reach in the solution of their coursework problems. The survey findings in chapter 4 have already evident that the informal learning of students at LC is based on the PBL technique. This study has the following implications for academic libraries as well as knowledge science.

5.5.1 Implications for LC in Academic Libraries and Academicians

The main point emerges from this study that has implications for library service delivery is that libraries, need to boost their commons spaces, improve and reorganize up to the mark services and resources, and provide services that support their users' preferred learning. The heart of learning commons is learning. LC has created a unique learning pedagogy in the academia by introducing designated learning spaces in out of class environment. Now the library authority needs to concentrate on PBL process-based user-centered learning, knowledge sharing and acquisition in group learning and informal learning for mapping the complete picture of learning. They can determine it as PBL supported `Continuum of Learning` for LC. Librarians, LC staffs, tutoring staffs, IT staffs need to understand this continuum for better serve the learners in problem solving. The user-centered learning, group learning, and informal learning in out of class environment.

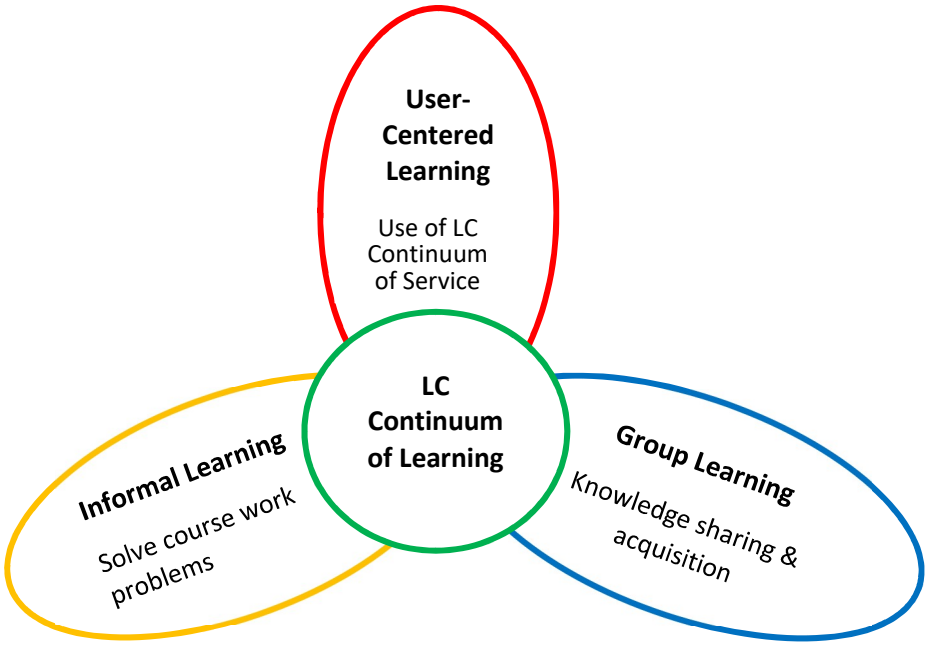

Figure 5.4 PBL supported Continuum of Learning in LC

In the wider world, learning is gaining recognition as a key factor for success of academic institutions. This research has explored PBL supported user-centered learning pedagogy in out of class space to the academic world. Academics need to contribute their knowledge to make the pedagogy fruitful in academia.

5.5.2 Implications for Knowledge Science

Knowledge management (KM) has been regarded as a process that covers the creation, capture, identification, organize, store, sharing and acquisition or use of knowledge (Aharony, 2011). Knowledge sharing and acquisition is a collaborative process which leads to generating new knowledge and ideas and that helps to solve our real-life problems. The main axiom of knowledge science is to create, share and use knowledge for getting maximum output of its resources. It has been evident in academic libraries that advanced technology setting and collaborative learning space leverage knowledge co-creation through knowledge sharing and acquisition of the learners (Lee & Schottenfeld, 2014). Learning commons is a user centered approach of the libraries intended to provide a vibrant space for learning of today`s library users. The intention of this space is to give opportunity to the learners for group learning outside of the classroom. The result of this

present research has evidenced that knowledge sharing and acquisition is contributing as a mediating factor of learning at learning commons. It helps the learners to generate new ideas and gradually proceed to problem conclusion.

Knowledge science is a multidisciplinary concept and LIS professionals of this age need to extend their focus at the user learning level. They need to integrate resources at LC with an aim to create an environment for knowledge sharing and acquisition among the users outside of class. The present study has contributed to show that KM is playing a role in user learning of academic libraries. The implication of this research needs to widen the concentration of LIS professionals from the narrow objectives of LC. They need to align its services, spaces, and resources. This present research can contribute more to knowledge science by adding valued services with much concentration of knowledge sharing and acquisition in user learning at LC.

5.6 Limitations and Future Research

This study has some limitations, which opens up new avenues for further study.

Firstly, the research sample was drawn only from Japan and three universities were included in the survey. More survey samples from the other countries may incorporate different opinions of the respondents and surely increase the reliability of the study.

Secondly, the survey instrument was prepared in English, and it was found that some Japanese respondents are not always comfortable with it. There was a possibility to express their opinion without understanding the query.

Thirdly, the study has put forward the problem-based learning method to see the user-centered learning at LC. It did not check the motivation and strategies of the learners as the reasons why they are coming to this space to use for learning. Further study needs to see the self-directed learning (SDL) and self-regulated learning (SRL) methods of user-centered learning at LC.

Finally, the present study considers that the combined understand of Problem-Based Learning (PBL), Self-directed learning (SDL) and Self-regulated learning (SRL) methods of constructivist learning theory would make the User-Centered Learning (UCL) as a wide-ranging learning pedagogy in the academia.

References

Ab Hamid, M. R., Sami, W., & Sidek, M. M. (2017, September). Discriminant validity assessment: Use of Fornell & Larcker criterion versus HTMT criterion. In *Journal of Physics: Conference Series*, IOP Publishing.

Afari, E. (2013). The Effects of Psychosocial Learning Environment on Students' Attitudes Towards Mathematics. In *Application of Structural Equation Modeling in Educational Research and Practice*, Khine, M. S. (edt).

Aharony, N. (2011). Librarians' attitudes toward knowledge management. *College & Research Libraries*, *72*(2), 111-126.

Alam, M. K., Umemoto, K. & Yoshida, T. (2016). Co-creating values at learning commons in academic libraries. In *Proceedings of the international conference on library and information science* (pp. 314-328), Kyoto, July 12-14.

Alam, M. K., Yoshida, T. & Kohda, Y. (2016). Value Co-Creation at Learning Commons: A Service-Dominant Logic Perspective. *Proceedings of the 7th Asia-Pacific Conference on Library & Information Education & Practice* (A-LIEP 2016) (pp. 338-347), Nanjing, China, November 3-4.

Allen, D. E., Donham, R. S., & Bernhardt, S. A. (2011). Problem-based learning. *Evidence-Based Teaching: New Directions for Teaching and Learning*, no. 128, 21-29.

Allen, F. R., Mullins, J. L., & Hufford, J. R. (2007). Top ten assumptions for the future of academic libraries and librarians: A report from the ACRL research committee.

Alolah, T., Stewart, R. A., Panuwatwanich, K., & Mohamed, S. (2014). Developing a comprehensive safety performance evaluation framework for Saudi schools. *International Journal of Productivity and Performance Management*.

Amineh, R. J., & Asl, H. D. (2015). Review of constructivism and social constructivism. *Journal of Social Sciences, Literature and Languages*, *1*(1), 9-16.

Ando, M., Asakura, T. and Simons-Morton, B. (2005). Psychosocial influences on physical, verbal, and indirect bullying among Japanese early adolescents. *The Journal of Early Adolescence*, 25(3), 268-297.

Applegate, R. (2009). The library is for studying: student preferences for study space. *The Journal of Academic Librarianship*, 35(4), p. 341-346.

Apuke, O. D. (2017). Quantitative research methods: A synopsis approach. *Kuwait Chapter of Arabian Journal of Business and Management Review*, 6 (11), 40–47.

Babbie, E. R. (2011). *The basics of social research* (4 ed.). Belmont: Thomson Wadsworth.

Babin, B. J., & Attaway, J. S. (2000). Atmospheric affect as a tool for creating value and gaining share of customer. *Journal of Business Research*, *49*(2), 91-99.

Bailey, D. R. (2006). Information commons services for learners and researchers: evolution in patron needs, digital resources and scholarly publishing. *Library Commons*, 1.

Bailey, D. R. (2014). A commons for the digital age: flipping the commons into the cloud. *Providence College*. http://www.pingree.org/page.cfm? p=3113.

Bailey, D. R., & Tierney, B. (2008). Transforming library service through information commons: part 1- introduction. *Library Commons Basics*, paper 1. http://digitalcommons.providence.edu/lib_commons_basics/1.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.

Barrows, H. S. (1996). Problem-based learning in medicine and beyond: A brief overview. *New Directions for Teaching and Learning*, (68), 3-12.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.

Baryshev, R.A. (2021). From electronic to smart library systems: Concept, classification of services, scheme of work and model. *Journal of Siberian Federal University. Humanities & Social Sciences*, 14(3), 426–443.

Baryshev, R.A., Verkhovets, S.V., & Babina, O.I. (2018), The smart library project: Development of information and library services for educational and scientific activity, *The Electronic Library*, 36(3), 535-549.

Beagle, D. (1999). Conceptualizing an information commons. *The Journal of Academic Librarianship*, *25*(2), 82-89.

Beagle, D. (2002). Extending the information commons: From instructional testbed to internet 2. The Journal of Academic Librarianship, 28(5), 287-296.

Beagle, D. R. (2006). *The information commons handbook*. New York: Neal-Schuman Publishers.

Beagle, D. (2008). The learning commons in historical context. *Annals of Nagoya University Library Studies*, *7*, 15-24.

Beagle, D. (2012). The Emergent Information Commons: Philosophy, models, and 21st century learning paradigms. *Journal of Library Administration*, 52(6-7), 518-537.

Beatty, S., & White, P. (2005). Information commons: Models for e-literacy and the integration of learning. *Journal of E-Literacy*, *2*(1), 1-14.

Bennett, S. (2003). *Libraries designed for learning*. Washington, DC: Council on Library and Information Resources.

Bennett, S. (2008). The information or the learning commons: which will we have? *Journal of Academic Librarianship*, 34(3), 183–185.

Bennett, S. (2009). Libraries and learning: A history of paradigm change. *Portal: Libraries and the academy*, 9(2), 181-197.

Bennett, S. (2015). Putting learning into library planning. *Portal: Libraries and the Academy*, 15(2), 215-231.

Brandon, A. F., & All, A. C. (2010). Constructivism theory analysis and application to curricula. *Nursing Education Perspectives*, 31(2), 89-92.

Brown, M. (2005). Learning spaces. In Diana G. Oblinger, & James L. Oblinger (Eds.), *Educating the Net generation* (pp. 12.1–12.22). Louisville, CO: Educause.

Brown, T. H. (2005). Beyond constructivism: Exploring future learning paradigms. *Education today*, *2*(2), 1-11.

Bruffee, K. A. (1999). *Collaborative learning: Higher education, interdependence, and the authority of knowledge*. 2nd ed. Baltimore: Johns Hopkins University Press.

Bruner, J. (1990). *Acts of Meaning.* Cambridge, MA: Harvard University Press.

Caffarella, R. S., & Merriam, S. B. (1999). Perspectives on adult learning: Framing our research. In *40th Annual Adult Education Research Conference Proceedings*. DeKalb, IL: Northern Illinois University.

Cao, G., Liang, M., & Li, X. (2018). How to make the library smart? The conceptualization of the smart library. *The Electronic Library*. 36(5), 811-825.

Carr, R. (2006). What users want: An academic" hybrid" library perspective. *Ariadne*, (46), 2.

Casey, M. E., & Savastinuk, L. C. (2006). Service for the next-generation library. *Library journal*, *131*(1), 40-42.

Chen, C. F., & Tsai, D. (2007). How destination image and evaluative factors affect behavioral intentions?. *Tourism management*, *28*(4), 1115-1122.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern methods for business research*, *295*(2), 295-336.

Cook, C., Heath, F., & Thompson, R. L. (2000). A meta-analysis of response rates in web-or internet-based surveys. *Educational and psychological measurement*, *60*(6), 821-836.

Commons. (2020). In *Wikipedia*. https://en.wikipedia.org/wiki/Commons.

Constructivism (philosophy of education). (2020). In *Wikipedia*. https://en.wikipedia.org/wiki/Commons.

Cowgill, A., Beam, J., & Wess, L. (2001). Implementing an information commons in a university library. *The Journal of Academic Librarianship*, *27*(6), 432-439.

Creswell, J.W. (2003), *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 2nd ed., Sage Publications Inc, Thousand Oaks, CA.

Dahlgren, M. A., & Dahlgren, L. O. (2002). Portraits of PBL: Students' experiences of the characteristics of problem-based learning in physiotherapy, computer engineering and psychology. *Instructional Science*, *30*(2), 111-127.

De Graaff, E., & Kolmos, A. (2003). Characteristics of problem-based learning. *International Journal of Engineering Education*, 19(5), 657-662.

De Houwer, J., Barnes-Holmes, D., & Moors, A. (2013). What is learning? On the nature and merits of a functional definition of learning. *Psychonomic Bulletin & Review*, *20*(4), 631-642.

Doiron, R., & Asselin, M. (2011). Exploring a new learning landscape in tertiary education. *New Library World*. 112(5/6), 222-235.

Donkai, S., Toshimori, A., & Mizoue, C. (2011). Academic libraries as learning spaces in Japan: Toward the development of learning commons. *The International Information & Library Review*, *43*(4), 215-220.

English, M. C., & Kitsantas, A. (2013). Supporting student self-regulated learning in problem-and project-based learning. *InterdisciplinaryJjournal of Problem-Based Learning*, 7(2), 128-150.

Elliott, S.N., Kratochwill, T.R., Littlefield, C.J. & Travers, J. (2000). *Educational psychology: Effective teaching, effective learning (3rd ed.)*. Boston, MA: McGraw-Hill College.

Eyisi, D. (2016). The usefulness of qualitative and quantitative approaches and methods in researching problem-solving ability in science education curriculum. *Journal of Education and Practice*, *7*(15), 91-100.

Farrugia, P., Petrisor, B. A., Farrokhyar, F., & Bhandari, M. (2010). Research questions, hypotheses and objectives. *Canadian Journal of Surgery*, 53(4), 278.

Ferguson, C. J. (2009). An effect size primer: A guide for clinicians and researchers. *Professional Psychology: Research and Practice*. 40(9), 532-538.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18,* 39-50.

Fox, R. (2001). Constructivism examined. *Oxford review of education*, 27(1), 23-35.

Gardner, S. & Eng, S. (2005). What Students Want: Generation Y and the Changing Function of the Academic Library. Portal: Libraries and the Academy, Vol. 5, No. 3, p. 405-420.

Geoffrey T. Freeman, "The Academic Library in the 21st Century: Partner in Education," in Building Libraries for the 21st Century: The Shape of Information, ed. T. D. Webb (Jefferson, NC: McFarland, 2000), 168–75.

Gerbing, D. W., & Anderson, J. C. (1992). Monte Carlo evaluations of goodness of fit indices for structural equation models. *Sociological Methods & Research*, *21*(2), 132-160.

Gibbs, G. (1992). *Assessing more students.* Oxford: Oxford Brookes University.

Gillette, D. D., & Somerville, M. M. (2006). Toward lifelong knowledge making: Faculty development for student learning in the Cal Poly Learning Commons. In *Lifelong Learning-Partners, Pathways, and Pedagogies: Proceedings of the 4th International Lifelong Learning Conference* (pp. 117-123).

Gul, S., & Bano, S. (2019). Smart libraries: an emerging and innovative technological habitat of 21st century. *The Electronic Library*. 37(5), 764-783.

Gupta, A. K., & Govindarajan, V. (2000). Knowledge Flows within Multinational Corporations. *Strategic Management Journal, 21*, 473-496.

Hair, Jr., J. E., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). New Jersey: Prentice-Hall.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*. 31(1), 2-24.

Hein, G. E. (1991). *Constructivist learning theory. Institute for Inquiry.* Available at:/http://www.exploratorium.edu/ifi/resources/constructivistlearning.html.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn?. *Educational psychology review*, *16*(3), 235-266.

Huang, H. M. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology*, 33(1), 27-37.

Jain, P. (2013). Knowledge management in academic libraries and information centres: A case of university libraries. *Journal of Information & Knowledge Management*, *12*(04), 1-13.

Jankowska, M. A., & Marcum, J. W. (2010). Sustainability challenge for academic libraries: Planning for the future. *College & research libraries*, *71*(2), 160-170.

Johnson, B.L. and Lilly, R. (2012). Current Challenges Facing U.S. Academic Libraries- From a 2012 Elsevier & Digital Resources Acquisition Alliance Event.

Khasawneh, F. A. (2013). *Student-Centered Learning Pedagogy as Innovative Place Maker in Campus* (Doctoral dissertation, Mie University).

Khasawneh, F.A., Shibayama, Y., Kato, A., Mori, S., & Taniguchi, G. (2011). *Emerging Learning Commons in Japanese Academic Libraries: Behavioral Aspects of Actual Usage*
and Communication Patterns, In proceedings of the 42nd Annual Conference of the Environmental Design Research Association, Chicago, Illinois, May 25-28, p.145-153.

Kline, R. B. (2010). Principles and practices of structural equation modeling (3rd ed.). New York: Guilford Press.

Krosnick, J. (1999). Survey research. *Annual Review of Psychology*, *50*, 537-567.

Lagerstrom, K., & Andersson, M. (2003). Creating and sharing knowledge within a transnational team: the development of a global business system. *Journal of World Business*, 38(2), 84-95.

Lauriden, B., & Cruz, A. (2013). Knowledge sharing and problem-based learning. In *Proceedings of ASBBS*, *20*(1), 423-435.

Lee, Y. S. and Schottenfeld, M.A. (2014). Collaborative Knowledge Creation in the Higher Education Academic Library, Journal of Learning Spaces, 3(1).

Leedy, P. & Ormrod, J. (2001). *Practical research: Planning and design* (7th ed.). Upper Saddle River: NJ.

Lewis, D. W. (2007). A strategy for academic libraries in the first quarter of the 21st century. College & Research Libraries, 68(5), 418-434.

Lippincott, J. K. (2005). Net Generation Students and Libraries. *Educause Review*, 40(2), 56-66.

Lippincott, J. K. (2006). *Linking the information commons to learning*. In D. Oblinger (Ed.), Learning Spaces. Washington, DC; Boulder, CO: Educause.

Loyens, S. M., & Gijbels, D. (2008). Understanding the effects of constructivist learning environments: Introducing a multi-directional approach. *Instructional science*, 36(5), 351-357.

MacWhinnie, L. A. (2003). The Information Commons: The Academic Library of the Future. *portal: Libraries and the Academy*, 3(2), 241-257.

Majid, N. A. A. (2014). Integration of web 2.0 tools in learning a programming course. *Turkish Online Journal of Educational Technology-TOJET*, *13*(4), 88-94.

Majid, S., & Chitra, P. K. (2013). Role of knowledge sharing in the learning process. *Literacy Information and Computer Education Journal (LICEJ)*, *2*(1), 1201-1207.

Martinez-Ruiz, A., & Aluja-Banet, T. (2009). Toward the definition of a structural equation model of patent value: PLS path modelling with formative constructs. *REVSTAT–Statistical Journal*, *7*(3), 265-290.

Maury, Y. (2012, November). Information and Knowledge Management in Libraries: the Reference Texts in Question. In *2nd International Symposium ISKO-Maghreb'2012-Concepts and Tools for Knowledge Management*.

McCabe, A., & O'Connor, U. (2014). Student-centred learning: the role and responsibility of the lecturer. *Teaching in Higher Education*, *19*(4), 350-359.

McLeod, S. A. (2019). *Constructivism as a theory for teaching and learning*. Simply Psychology. https://www.simplypsychology.org/constructivism.html

McMullen, S. (2008). US academic libraries: Today's learning commons model. PEB Exchange 4, MA: OECD.

Mergendoller, J. R., Maxwell, N. L., & Bellisimo, Y. (2006). The effectiveness of problem-based instruction: A comparative study of instructional methods and student characteristics. *Interdisciplinary journal of problem-based learning*, *1*(2), 49-69.

Milne, A. J. (2006). Designing blended learning space to the student experience. In Diana G. Oblinger (eds.), *Learning Spaces*, Boulder: EDUCAUSE, 11.1-11.15.

Mohd-Yusof, K., Helmi, S., Jamaludin, M. Z., & Harun, N. F. (2011). Cooperative problem-based learning (CPBL): A practical PBL model for a typical course. *International Journal of Emerging Technologies in Learning*, *6*(3), 12-20.

Nagata, H. (2008). New `ba` (locale) in academic libraries: Information commons and learning commons. *Annals of Nagoya University Library Studies*, *7*(1), 3–14.

Neuman, W. L. (2007). *Basics of social research: Qualitative and quantitative approaches* (2nd ed.). Boston: Pearson.

Nitecki, D. A., & Simpson, K. (2016). Communicating the library as a learning environment. *Journal of Learning Spaces*, 5(2), 39-52.

Oblinger, D. G. & Oblinger, J. L. (2005). Is it age or IT: First steps toward understanding the net generation. In J. Oblinger, D. Oblinger (eds.) *Educating the Net Generation*, Boulder: EDUCAUSE.

Oldfather, P., & Dahl, K. (1994). Toward a social constructivist reconceptualization of intrinsic motivation for literacy learning. *Journal of Literacy Research*, 26(2), 139-158.

Oliveira, S. M. (2018). Trends in academic library space: from book boxes to learning commons. *Open information science*, *2*(1), 59-74.

Oliveira, A. M. C. A., dos Santos, S. C., & Garcia, V. C. (2013, October). PBL in teaching computing: An overview of the last 15 years. In *2013 IEEE Frontiers in Education Conference (FIE)* (pp. 267-272). IEEE.

O'Neill, G., & McMahon, T. (2005). Student-centred learning: What does it mean for students and lecturers?. In: O'Neill, G., Moore, S., McMullin, B. (Eds). *Emerging Issues in the Practice of University Learning and Teaching*. Dublin: AISHE.

Onwuegbuzie, A., Teddlie, C., & Tashakkori, A. (2003). Handbook of mixed methods in social & behavioral research. Thousand Oaks, CA: Sage.

Perkins, R. A. (2011). Using research-based practices to increase response rates of web-based surveys. *Educause Quarterly, 34*(2), 9-17.

Piaget, J. (1973). *To understand is to invent: The future of education.* New York: Grossman.

Ping, R. A. (2009). Is there any way to improve Average Variance Extracted (AVE) in a Latent Variable (LV) X (Revised)? [on-line paper]. http://www.wright.edu/~robert.ping/ImprovAVE2.doc)

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning*, 1 (1), 9-20.

Scupola, A., & Nicolajsen, H. W. (2010).Service innovation in academic libraries: Is there a place for the customers? *Library Management*, *31*(4/5), 304-318.

Sekaran, U. (2003), Research Methods for Business: A Skill Building Approach, 4th ed., JohnWiley & Sons Inc, New York, NY.

Shank, J. D. (2006). The blended librarian: A job announcement analysis of the newly emerging position of instructional design librarian. *College & Research Libraries*, 67(6), 514-524.

Siddike, M. A. K., Umemoto, K., & Kohda, Y. (2014, August). Transformation of public libraries: co-creation of values at multipurpose community learning centers. In *2014 IIAI 3rd International Conference on Advanced Applied Informatics* (pp. 109-114). IEEE.

Simmonds, P. L., & Andaleeb, S. S. (2001). Usage of Academic Libraries: Role of Service. *Library Trends*, 49(4), 626-634.

Sinclair, B. (2009). The blended librarian in the learning commons: New skills for the blended library. *College & Research Libraries News*, 70(9), 504-516.

Smith, F. (1975). *Comprehension and Learning*. New York: Holt, Rinehart & Winston.

Somerville, M. M., & Brar, N. (2006). Collaborative co-design: the cal poly digital teaching library user centric approach. *Library Scholarship*, Vol. 24, 1-14.

Somerville, M. M., & Collins, L. (2008). Collaborative co-design: a learner-centered library planning approach. *The Electronic Library*, 26(6), p. 803–820.

Somerville, M. M., & Harlan, S. (2008). From information commons to learning commons and learning spaces: An evolutionary context. In S. Barbara (Eds.), *Learning Commons: Evolution and Collaborative Essentials* (1-36). Oxford: Chandos.

Thomas, C., & McDonald, R. H. (2005). *Millennial Net Value(s): Disconnects Between Libraries and the Information Age Mindset*. Florida State University D-Scholarship Repository, 93-105. Available at: https://www.researchgate.net/profile/ Robert_ Mcdonald4/publication/

Thomas, A. M. & Veloutsou, C. (2013). Beyond Technology Acceptance: Brand Relationship and Online Brand Experience. *Journal of Business Research*, 66(1), 21-27.

Tick, A. (2007, January). Application of problem-based learning in classroom activities and multimedia. In *5th Slovakian Hungarian joint symposium on applied machine intelligence and informatics, Poprad, Slovakia*.

von Glaserfeld, E. (1984). An introduction to radical constructivism. In P. Watzlawick (Ed.), *The Invented Reality* (pp. 17-40). New York: Norton.

Van Tonder, E., & Petzer, D. J. (2018). The interrelationships between relationship marketing constructs and customer engagement dimensions. *The Service Industries Journal*, *38*(13-14), 948-973.

Vygotsky, L. (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Williams, C. (2011). Research methods. *Journal of Business & Economics Research (JBER)*, *5*(3).

Yin, R. K. (2009). *Case study research: Design and methods*, (5th ed.). Sage Publications Inc, Thousand Oaks, CA.

Yip, K. H. T., Lo, P., Ho, K. K., & Chiu, D. K. (2021). Adoption of mobile library apps as learning tools in higher education: A tale between Hong Kong and Japan. *Online Information Review*, 45(2), 389-305.

Zhang, Y. (2000). Using the internet for survey research: a case study. *Journal of the American Society for Information Science*. 51(1), 57-68.

Appendix A: Questionnaire

Questionnaire on Problem Solving Practices in Students' Learning at Learning Commons of Academic Libraries

Background

This survey is being undertaken as a part of my doctoral research. The aim of the survey is to know your practices regarding solving learning problems as a user of Learning Commons (LC) of your university library as well as to know how group work is helping in your problem solving.

Participation

The survey takes approximately 10 minutes to complete. It is conducted online and participation is voluntary. If you are a user of the Learning Commons of your university library (Group Learning Spaces, Presentation Studio, Café, etc.) then you are requested to participate in the survey.

Confidentiality

Strict confidentiality will be maintained for all responses and the data and information provided by you will be used for my doctoral dissertation and journal or conference papers. In order to confirm the confidentiality, results of the survey will be aggregated and your participation will remain anonymous.

Guidelines

Each section of this questionnaire will ask you about 4-6 questions. You do not need to write or type any answer, rather you have to choose your answer from a 7-point answer scale that best reflects your opinion.

7 Point Answer Scale

1 Strongly disagree

2 Disagree

3 Disagree somewhat

4 Neither disagree nor agree (Neutral)

5 Agree somewhat

6 Agree

7 Strongly agree

Definition of Key Terms

Learning Commons

Learning Commons (LC) of a library provide physical, technological and social spaces and offer student learners and researchers to pursue numerous learning and research activities in those spaces.

Learning Problem

Learning problems are the students' assignment, presentation, project, examination, etc. for which they use the LC to learn with group mates for solving those problems.

Contact

If you have any questions or more information to know of this survey, please feel free to contact with the researcher:

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If you have further query or concerns about your rights as a research participant, please contact supervisor of this research:

Professor Dr. Youji Kohda

Japan Advanced Institute of Science and Technology (JAIST), Ishikawa, Japan

Email: kohda@jaist.ac.jp,

Thank you very much for your kind cooperation. Please click “NEXT” to start the survey.

Section 1: LC Use for Learning (LCUL)

Learning Commons (LC) provides various services, spaces and resources for enhancing learning among the students in the library building. LC has combined three interrelated and interdependent levels, Physical Commons, Virtual Commons and Cultural Commons. The users of LC makes use of services and resources from those three levels of commons

in their course studies learning problem solving process. Do you use those resources and services for your learning?

Construct	Question Number	Item scale	Variable(s)	Question
LC Use for Learning (LCUL)	Q24	LCUL1	Physical Commons	We use LC computer devices, designated space and library collection during learning
	Q25	LCUL2	Virtual Commons	LC portals, digital library collections, e-learning tools, productivity software helps us to prepare the solution
	Q26	LCUL3	Cultural Commons	LC social resources like workshops, tutoring programs, research collaborations and coaching help to generate new idea and create solution

Section 2: Knowledge Sharing and Acquisition (KSA)

Knowledge sharing and acquisition plays a role in every aspect of solving assigned learning problems. This activity helps you to gather previous knowledge and share knowledge among the groupmates and they integrate those with their own knowledge base and generate new ideas on the way to solve problems.

Construct	Question Number	Item scale	Variable(s)	Question
Knowledge Sharing and Acquisition (KSA)	Q20	KSA1	Understand new findings	We discuss about collected knowledge to understand new findings
	Q21	KSA2	Knowledge sharing	Discussion and sharing idea and knowledge help me to innovate new ideas
	Q22	KSA3	Integrate knowledge	In group discussion we integrate the collected knowledge
	Q23	KSA4	Combine knowledge & complete solution	By writing results we combine knowledge and develop new concepts with old one

Section 3: Problem Identification (PI)

Problem identification process develops a clear idea about the learning problems. Students use Learning Commons (LC) for solving their learning problems such as assignments, presentations, projects and examinations. Through various learning activities like discussion, sharing, feedback, etc. with group mates they try to understand and define the problem.

Construct	Question Number	Item scale	Variable(s)	Question
Problem Identification (PI)	Q1	PI1	Work with groupmate	Outside of classroom LC gives me the opportunity to work for solving learning problems with groupmates
	Q2	PI2	Determine the driving question	Here we determine the driving question that we need to answer for solving the problem
	Q3	PI3	Understand broad nature of the problem	Group learning helps me to understand the broad nature of the problem
	Q4	PI4	Gathering previous knowledge	LC learning helps me to organize ideas by gathering previous knowledge
	Q5	PI5	Improving problem solving skills	Learning in LC is improving my problem-solving skills

Section 4: Formulate Inquiry (FI)

Through inquiry students who are working in LC try to create the questions that they need to know for solving the problems. They gather information/knowledge from different sources and share it among group mates to find the knowledge gap for further query.

Construct	Question Number	Item scale	Variable(s)	Question
Formulate Inquiry (FI)	Q6	FI1	Several questions and unknown issues arise	In LC group work several questions and unknown issues arise that we need to know
	Q7	FI2	What information need to know further	I can understand what information we need to know further
	Q8	FI3	Take help and search information	We plan to take help from experts and search information
	Q9	FI4	Share and explain ideas	Here I share and explain my ideas
	Q10	FI5	Peer learning	Group mates teaches each other about the new findings

Section 5: Solution Creation (SC)

In this stage students start thinking about the possible solution of the problem. They try to make sense of the collected knowledge by developing new ideas and searching for the best solution.

Construct	Question Number	Item scale	Variable(s)	Question
Solution Creation (SC)	Q11	SC1	Determine important topics to know beginning	During LC learning I can determine which topic is important to know in the beginning
	Q12	SC2	Assign group or individual tasks	We assign group or individual tasks like information collection, report writing, creating presentation, etc. for solving the problems
	Q13	SC3	Create solution	We work to create the best possible presentation or solution of the problem
	Q14	SC4	Rehearsal and practice	While working in LC we rehearsal and revision our tentative presentation or solution
	Q15	SC5	LC programs	LC programs (lecture seminars, workshops, events, etc.) help me to generate the best solution.

Section 6: Problem Conclusion (PC)

This is the final stage where students are prepared for submitting their overall learning outcome and process outcome. Through numerous practices and revisions they combine the collected knowledge with the old concept and prepare the final presentation for best conclusion.

Construct	Question Number	Item scale	Variable(s)	Question
Problem Conclusion (PC)	Q16	PC1	Identify unknown issues	Through discussion we summarize relevant knowledge and identify what is needed to know more
	Q17	PC2	Decide the best solution	Through practice and preparation we try to decide the best ways for solution
	Q18	PC3	Group feedback	Based on group feedback we revise the presentation and evaluate its' accuracy
	Q19	PC4	Find unanswered issues for solution	While preparing the final solution we still find some unanswered issues

Alhamdhulillah