# Development and Validation of a TPACK-integrated Instructional Design Model for Technology Integration

## - A Context of Nepalese Teacher Education Program -

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## ―ネパールにおける教師教育プログラムを対象に―

A Dissertation Presented to

the Graduate School of Arts and Sciences

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for the Degree of Doctor of Philosophy

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2018 年 9 月 5 日

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## Goddess of Learning

## Maha Saraswoti

सरस्वती मया दृष्टा वीणापुस्तकधारिणी
हंसवाहनसंयुक्ता विद्यादानं करोतु मे

प्रथमं भारती नाम द्वितीयञ्च सरस्वती
तृतीयं शारदा देवी चतुर्थ हंसवाहिनी

पञ्चमं तु जगन्माता षष्ठं वागीश्वरी तथा
सप्तमं चैव कौमारी अष्टमं वरदायिनी

नवमं बुद्धिदात्री च दशमं ब्रह्मचारिणी
एकादशं चन्द्रघण्टा द्वादशं भुवनेश्वरी

द्वादशै तानि नामानि त्रिसन्ध्यं य पठेन्नरः
जिव्हाग्रे वसते तस्य ब्रह्मरूपा सरस्वती

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# Abstract

Technology integration are becoming integral part of the educational system in the twenty-first century for numerous opportunities such as: promoting teaching and learning effectiveness, addressing the teaching and learning load, making teaching and learning more flexible, enhancing classroom interactions (Hall & Higgins, 2005; Kennewell, 2001; Lopez, 2010; Smith, Higgins, Wall & Miller, 2005). This is why, developed as well as developing countries significantly investing their efforts regarding technological resources, professional training, and formulating national policies. However, as noted by Norris, Shullivan, and Poirot (2003), the availability of technological tools and instructors' technical competencies would not be enough because instructors need to know, how to utilize those resources and their technical competencies for implementing technology integration during classroom instructions.

To bring out technology integration, various ID models and framework such as ASSURE, Kemp's, SAMR, TPACK, and TPACK-based ID models have been developed and practiced by the instructors. Based on the empirical evidences, there are still some limitations among such ID models and framework as: (i) the lack of instructors' awareness regarding ID models, (ii) the need of expert guidance in utilizing various steps/phases of ID models, (iii) the increased time and financial burden to the educational institutions, (iv) SMAR model is very difficult to implement in practice because it lacks detailed guideline for instructors, (v) TPACK framework also lacks detailed structure for creating and implementing technology-integrated instructions considering content, pedagogy, and technology simultaneously, and (vi) TPACK-based ID

models exclusive focus to enhance PSTs' competencies in terms of TPACK but having a high level of TPACK competencies do not guarantee technology integration.

Thus, to address existing problems in the literature, a new TPACK-integrated ID model was developed and validated in a Nepalese context to assist instructors in creating and implementing technology-integrated instructions for technology integration. The TPACK-integrated ID model included *Worked Examples* in (i) utilizing key phases and key components of a TPACK-integrated ID model, and (ii) creating a technology-integrated lesson plan for classroom instruction.

To achieve the purpose, this study addressed the three major research questions as: (1) What are key phases and key components of a TPACK-integrated ID model applying a systems thinking approach? (2) How do TEP instructors implement a TPACK-integrated ID model for technology integration and (3) What changes do occur in preservice teachers' learning experiences while implementing technology-integrated instructions based on a TPACK-integrated ID model through *Worked Examples*?

*Design and Development* research having four stages was used to develop and validate a TPACK-integrated ID model. In stage 1, a TPACK-integrated ID model for the pilot study was developed based on the literature and expert consultations. After then, the pilot study was conducted in a Nepalese TEP by a TEP instructor which was done in stage 2. Similarly, stage 3 includes the development of a revised TPACK-integrated ID model and *Worked Examples* for the main study, which was based on the findings from the pilot study, peer reviews, advice from the faculty of education (ICU), and advisor consultations.

The study was conducted in Nepalese TEP, where three TEP instructors utilize a TPACK-integrated ID model through *Worked Examples*. Class observations, reflective journals, and interviews were employed to collect qualitative data. Similarly, PSTs' engagement checklists, perceived outcomes, paper-based tests, and questionnaires were used to collect quantitative data. Class observations, interviews, the reflective journals were analyzed to answer research questions 1 and 2 using manual coding under the few categories. The results of research question 1, showed that six key phases (*Analyze, Explore, Design, Develop, Implement*, and *Evaluate)* and several key components were found to be very useful to create and implement technology-integrated instructions by investigating various resources and re-confirming them in *Analyze* and *Explore* phase consecutively. In addition, *Worked Examples* in creating technology-integrated lesson plan became self-guided instructions for TEP instructors to integrate content, pedagogy, and technology simultaneously.

Research question 2 was also analyzed based on the qualitative data collections. The findings revealed that to utilize key phases and key components, *Worked Examples* assisted TEP instructors having various level of knowledge regarding content, pedagogy, and technology. Additionally, TEP instructors having low confident about technologies also found to implement technology integration with the support from educational institutions and utilizing convenient technologies.

Similarly, to answer research question 3, mean scores, a paired *t* test, and effect size *d* was calculated. In addition, classroom observations were also done. Findings revealed that PSTs' engagement level during classroom instructions and their perceived knowledge was found to be comparatively higher in the treatment groups compared with control groups among three cases.

As accordingly, *t* test scores were found to be significant in treatment groups regarding PSTs' self-efficacy toward technology integration and attitude toward technology. However, even if, statistical significance was not found in case 3, effect size (*d*) was high in the treatment group. In addition, classroom observations revealed that those PSTs who educated under technology-integrated instructions (based on a TPACK-integrated ID model through *Worked Examples*) was found to perceive an ability to utilize available technologies to educate the school students using various pedagogical strategies compared with those trained under as typical instructions.

In conclusions, a TPACK-integrated ID model through *Worked Examples* was able to assist TEP instructors having multifarious levels of knowledge regarding content, pedagogy, and technology in creating and implementing technology-integrated instructions. *Worked Examples* was found to be self-guided instructions to use various key phases and key components by minimizing their extraneous cognitive load and addressing first-order and second-order barriers to technology integration. Furthermore, the newly added *Explore* phase became very useful to address the first-order barriers (technological resources and training), which was also one of the major theoretical contribution of the study.

# 要旨

テクノロジーの統合は、教授や学習における、効果の促進、負担の軽減、柔軟性の向上、教室内での相互作用の促進など、21世紀の教育システムに不可欠な要素となっている（Hall & Higgins, 2005; Kennewell, 2001; Lopez, 2010; Smith, Higgins, Wall & Miller, 2005）。そのため、先進国と同じように発展途上国もテクノロジーの資源、専門技術、国家政策の策定に力を注いでいる。しかし、Norris、Shullivan そして Poirot（2003）が指摘したように、教師が教室での教授にテクノロジーを統合するには、テクノロジーツールや専門技術をどのように利用するかを知る必要があり、利用可能性は未だ十分に担保されていない。

テクノロジー統合のために、ASSURE、Kemp's、SAMR、TPACK、TPACK ベースインストラクショナルデザインモデルなどの様々なインストラクショナルデザインモデル（ID モデル）とフレームワークが教育者によって開発、実践されている。 経験的文献によると、ID モデルおよびフレームワークには、以下のような課題があると指摘する。（i）ID モデルに関する教育者の認識不足、（ii）ID モデルの利用における様々なステップやフェーズでの専門家の指導の必要性、 （iii）教育機関の拘束時間と財政負担の増加、（iv）SMAR モデルは教育者への詳細な指針がないため実践が非常に困難、（v）TPACK フレームワークもまた、授業計画を作成するための教授内容、教授法、技術を統合する詳細な構造が欠けている、 （vi）TPACK ベース ID モデルは教員課程履修者の TPACK に関する能力の向上は促進するが、高いレベルの TPACK の能力を有することは、技術の統合を保証するものではない。

そのため、文献によって示された既存の問題に対処するために、TPACK が統合された新しいID モデルを開発し、ネパールにおいて検証を行った。 TPACK 統合 ID モデルは、（i）TPACK 統合 ID モデルの主要段階と主要要素の活用（ii）教室指導のためのテクノロジー統合授業計画の作成、以上の実践手順を経て作成された。

先述した課題解決のため、本研究では 3 つの主要な研究課題を設定した。（1）システム思考アプローチに応用する上で TPACK 統合 ID モデルの主要段階と主要要素とは何か、（2）ネパールにある教員養成学校 TEP 講師は、テクノロジー統合のためにどのように TPACK 統合 ID モデルを活用可能か、（3）実践手順に沿って TPACK 統合 ID モデルを元にテクノロジーが統合された授業を行った際、教員養成課程の学習者の学習経験にどのような変化が生じるか。

設計・開発の段階では TPACK 統合 ID モデルの開発と検証のため、３つの段階を踏んだ。 第１段階では、予備研究のための TPACK 統合 ID モデルが、先行研究と専門家の協議に基づいて開発された。 その後、第 2 段階では予備研究によって開発された TPACK 統合 ID モデルが TEP の講師によって実施された。そして第 3 段階では、予備研究から得られた知見、ピアレビュー、教育学部（ICU）からの助言、および指導教諭からの助言を元に改訂された TPACK 統合 ID モデルの開発と、主研究のための実践手順を行った。

調査はネパールの教員養成プログラムで実施され、3 名の教員養成講師が実践手順を経て、TPACK 統合 ID モデルを実践した。質的データを収集するために、授業観察、授業日誌、およびインタビューを採用した。同様に、教員養成課程の学生のエンゲージメントチェックリスト、知覚結果、筆記のテスト、およびアンケートを使用して定量データの収集を行った。 研究課題１・２に答えるため、いくつかのカテゴリーのもとマニュアルコーディングを使用し、

授業観察、インタビュー、授業日誌の分析を行った。研究課題 1 の答えとして、分析、探索、設計、開発、実装、評価が 6 つの重要な段階であるとわかり、分析・探求の段階においてさまざまなリソースを調査して再統合することにより、テクノロジーを統合した授業計画を作成することが主要な要素であることでも明らかになった。さらに、テクノロジーを統合した授業計画を作成するための実践手順は、教員養成講師が教授内容、教授法、テクノロジーを統合するための自己学習形式にした。

研究課題 2 についても質的データに基づいて分析を行った。この調査結果は、主要な段階と主要要素を活用する上で、実践手順が教授内容、教授法、テクノロジーに関するさまざまなレベルの知識を持つ TEP 講師を支援したことを明らかにした。さらに、テクノロジーについて自信がない TEP 講師は、教育機関のサポートと便利なテクノロジーを活用してテクノロジーの統合を実施することも見出した。

同様に、研究課題 3 に答えるため、平均値、対応のある $t$ 検定、および効果量 $d$ を計算した。さらに、授業観察も分析対象とした。教室の指導中の教員養成課程の学生のエンゲージメントレベルと知覚知識は、３つのケースにおいてコントロールグループに比べてトリートメントグループで比較的高いことが判明した。それに応じて、t 検定のスコアは、テクノロジーの統合とテクノロジーに対する態度における教員養成課程学生の自己効力感に関して、トリートメントグループで有意であることが判明した。ケース 3 では統計的有意性が認められなかったが、トリートメントグループでは効果サイズ（d）が高かった。加えて、授業観察によると、テクノロジーが統合された教授（実践手順に沿った TPACK 統合 ID モデルに基づく）を受けた教員養成課程の学生は、利用可能なテクノロジーを駆使して学校の生徒を様々な教育戦略で教育する能力を通常の授業の中で認識したことがわかった。

結論として、実践手順を通じた TPACK 統合 ID モデルは、テクノロジーを統合した授業計画を作成する際に、教授内容、教授法、テクノロジーに関してさまざまなレベルの知識を持つ TEP 講師の支援につながった。 実践手順は、不要な認知負荷を最小限に抑え、技術統合に対する一時および二次次障壁に対処するために、さまざまな主要段階、主要要素を用いる自己学習形式になった。さらに、新たに追加された探索段階は、一次障壁（テクノロジー資源とトレーニング）に対処するのに非常に役立つことがわかった。

# Table of Contents

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*For*

*Devi Ratna Bajracharya, the greatest dad of the world*

*Yeachu Devi Bajracharya, the greatest mom of the world*

*Jen Bajracharya, the greatest brother of the world*

*Jeena, Subash, and Puzana, the rightful one and beautiful sisters*

*For*

*Dinu Bajracharya, the best friend and beloved better half*

*Jinu Bajracharya, precious angel and supreme landmark of flexibility*

*For*

*Grand Parents*

*Late Nanda Ratna Bajracharya*

*Late Lali Devi Bajrachaya*

# List of Tables

# List of Figures

# Acronyms

| | |
|---|---|
| ADDIE | Analyze, Design, Develop, Implement, and Evaluate |
| ASSURE | Analyze, State, Select, Utilize, Require, Evaluate and Revise |
| B.Ed. | Bachelors of Education |
| DoE | District of Education |
| GoN | Government of Nepal |
| ICT | Information and Communications Technology |
| ICU | International Christian University |
| ID | Instructional Design |
| MIC-Nepal | Microsoft Innovation Center Nepal |
| MoE | Ministry of Education |
| NPC | National Planning Commission |
| OLE-Nepal | Open Learning Exchange Nepal |
| PCK | Pedagogical Content Knowledge |
| PST | Preservice Teachers |
| SAMR | Substitution, Augmentation, Modification, and Redefinition |
| TEP | Teacher Education Program |
| TPACK | Technological Pedagogical and Content Knowledge |
| TPACK-COPR | TPACK-Comprehension, Observation, Practice, and Reflection |
| TPACK-IDDIRR1 | TPACK- Introduce, Demonstrate, Develop, Implement, Reflect, and Revise (first prototype) |
| TPACK-IDDIRR2 | TPACK- Introduce, Demonstrate, Develop, Implement, Reflect, and Revise (second prototype) |

| | |
|---|---|
| UNESCO | United Nations Educational, Scientific and Cultural Organizations |
| UNICEF | United Nations International Children's Education Fund |

# Chapter 1: Introduction

This chapter covers the background of the study and related problems. It states the purpose of the study and subsequent research questions along with definitions of selected terms.

## Background of the Study

As argued by numerous researchers and practitioners, Information and Communications Technology (ICT) has become an integral part of the educational system in the twenty-first century learning environment both in the developed and developing countries (Clements & Sarama, 2003; Haugland, 2005; McKenney & Voogt, 2012; Parette & Blum, 2013; Yelland 2005). Kozma (2002, p.2) highlighted that increased utilization of “ICT into classroom and curricula” is to improve educational systems and prepare the learners for the twenty-first century. Further, as reported by Ajjan and Hartshrone (2008) and Pelgrum and Anderson (1999), developed countries from Europe, North America, and the Asia Pacific region significantly increased the number of computers, amount of professional training, and availability of internet access in schools to provide additional opportunities for their learners to be actively involved in learning since the 1990s.

Chinn and Fairlie (2010) reported that the penetration rate of computer resources, training, and internet users are comparatively low in developing countries. However, a recent report from the World Bank shows that government plans and policies in ICT have already been carried out by the developing countries in education even when lacking resources (World Bank, 2012). Using the South Asian countries as an example, national level movements of ICT in education were launched since 1992 in India, 2000 in Nepal, 2002 in Bangladesh and Sri Lanka, 2003 in Afghanistan and Bhutan, 2005 in Pakistan, and 2006 in the Maldives to improve the quality of education through building instructors' capacity by providing training for implementing ICT in classroom teaching (World Bank, 2010). Further, an international organization such as United Nations Educational, Scientific and Cultural Organization (UNESCO) has been providing technical assistance for the enhancement of instructors' technical competencies in the developing countries (UNESCO, 2008). These efforts from various stakeholders including national bodies, international organizations, and donor agencies were focused on enhancing the instructors' technical competencies (the term *competencies* is used throughout the study in the place of knowledge and skills) for the utilization of ICT in classroom instruction.

As reported by numerous studies, the utilization of ICT in classroom instruction is crucial because ICT (the term *ICT* and *technology* are used interchangeably throughout the study) opens up numerous opportunities such as: promoting teaching and learning effectiveness, addressing the teaching and learning load, making teaching and learning more flexible, and enhancing classroom interactions (Hall & Higgins, 2005; Kennewell, 2001; Lopez, 2010; Smith, Higgins, Wall, & Miller, 2005). Furthermore, technology supports learners to understand the subject matter (Taylor, Harlow, & Forret, 2010) while enhancing their engagement in the classroom activities leading to purposeful learning (Jang, 2012). YouTube videos, educational blogs, social media, software, and applications, which encourage learners to think beyond the four walls of the classroom, play an important role in education to improve learning (Gilory, 2010; Haddad & Draxler, 2002). In addition, technology helps learners to be critical thinkers, communicators, collaborators, creators, and problem-solvers to eventually become effective and efficient citizens, workers, and future leaders of the nation (Cynthia, 2015). Technology in education, therefore, is important to improve teaching and learning in the twenty-first century society.

However, as Bitner and Bitner (2002), Gulbahar (2007), and Pierson (2001) mentioned for technology to be truly effective in education, appropriate technology integration in teaching and learning is essential. The U.S. Department of Education (2002, p.174) has defined the term *technology integration* as "the incorporation of technology resources and technology-based practices" into teaching and learning. As mentioned by Hunter (2015), an incorporation of technology resources refers to the use of technological tools in teaching and learning in general content areas. Further, technology-based practices serve to enhance instruction that also supports the learners' learning (Amy & Katina, 2014; Richard, 2009).

Meanwhile, Mishra and Koehler (2006) argued that technology integration is not about putting technological resources together and replacing the technical skills in regular classrooms to enhance the learners' learning. As noted by Norris, Shullivan, and Poirot (2003), the availability of technological tools and instructors' technical competencies could create the possibility of technology integration but their competencies in creating technology-integrated instructions by implementing pedagogical strategies for the content are also crucial for carrying out technology integration. Therefore, technological resources and instructors' technical competencies could not be enough for bringing technology integration during classroom instruction.

Recent developments in the field of educational technology have led to a renewed interest in considering the three specific elements in technology integration consisting of *Technology*, *Pedagogy*, and *Content* as specified by Koehler and Mishra (2005). Further, Mishra and Koehler (2006) organized those elements into three major areas of knowledge including *Technological Knowledge*, *Pedagogical Knowledge*, and *Content Knowledge* required by instructors for technology integration, which is termed as Technological Pedagogical and Content Knowledge (TPACK). TPACK is a conceptual framework that builds on Shulman's (1986, p.12) theoretical basis of Pedagogical Content Knowledge (PCK) referring to the "instructors' understanding of technologies and PCK" for bringing technology integration in the classroom instruction (Koehler & Mishra, 2008; Mecoli, 2013). A TPACK framework addresses the complexity of teaching by integrating technologies and pedagogical strategies simultaneously to deliver the required content during classroom instruction, which focuses on the enhancement of instructors' competencies for technology integration (Mishra & Koehler, 2006; Mishra & Koehler, 2009; Mishra, Koehler, & Kereluik, 2009). Thus, in the study, technology integration is defined as an implementation of technological resources and pedagogical strategies to deliver the required content knowledge during classroom instruction.

As discussed above, technology integration is very important in the twenty-first century learning society. Various components such as access to the technological resources, training for enhancing instructors' technical competencies, and favorable governmental plans and policies have been practiced to bring technology integration. However, studies by numerous researchers revealed that these components are still not sufficient because technology-equipped classrooms and instructors' technical competencies alone do not guarantee in practicing successful technology integration (Kim, Kim, Lee, Spector, & DeMeester, 2013; Polly, Mims, Shepherd, & Inan, 2010). Meanwhile, studies done by Brickner (1995) and Vataartiran and Karadeniz (2015) made a case for the importance of instructors' personal beliefs in technology integration because it was related to their attitudes toward technology integration. Other studies such as Bauer and Kenton (2005), Ertmer (2005) and Tsai and Chai (2012) revealed that instructors' competencies for creating technology-integrated instructions are the most important because they are not able to carry out technology integration in the classroom, even with the presence of enough technological resources and having a positive attitude toward technology integration (the term *technology-integrated instructions* is used throughout the study in the place of *a content-pedagogy-technology integrated instruction*). These studies highlighted the importance of instructors' competencies in designing and developing technology-integrated instructions because instructors are autonomous agents with the power to make decisions in their instruction.

As found by Hunter (2015, p.5), technology integration "is not easy" because many instructors prefer to simply add technological tools to the classroom, for example by utilizing word processing for literacy tasks and Excel spreadsheets for entering numerical data without considering its effects on learners' learning experiences. In addition, Dockstader (1999, p.73) argued that the substitution of 30 minutes of reading with 30 minutes of computer skill development is a poor example of technology integration. All these studies reveal that the act of technology integration into teaching and learning is a complex process hindered by several barriers.

Brickner (1995), Ertmer (1999), and Tsai and Chai (2012) discussed three types of barriers to technology integration: such as first-order, second-order, and third-order barriers. The first-order barrier is an external factor that includes a lack of adequate resources, time, training, and institutional support. The second-order barrier is related to personal beliefs, which is more instructor-centered relating to instructors' attitudes toward technology integration. These attitudes consist of the instructors' self-efficacy toward technology integration and attitude toward technology. The second-order barriers are the main causes for the instructors' willingness to adopt technology in education in the first place. The third-order barrier refers to instructors' competencies in creating technology-integrated instructions for the classroom instruction. It is associated with the utilization of technological resources with appropriate pedagogical strategies to deliver the content during classroom instruction.

As argued by the number of authors, even if the first-order and second-order barriers are resolved, technology integration may not necessarily proceed naturally without addressing the third-order barriers which are associated with the instructors' competencies for creating technology-integrated instructions (Albirini, 2006; Almekhlafi & Almeqhadi, 2010; Goktas, Yildirim, & Yildirim, 2009; Lim & Chai, 2008; Lim & Pannen, 2012; Tsai & Chai, 2012). In particular, Jhurree (2005) argued that instructors from developing countries possess a high level of apprehension to integrate technology in the classroom because they lack the necessary competencies to create technology-integrated instructions, even if they possess high levels of technical knowledge. This shows that the instructors' competencies for creating technology-integrated instructions are crucial for implementing technology integration in the classroom.

In the context of Nepal, Karmacharya (2015) reported that Nepalese instructors require a lot of continuous guidance and support to integrate technology while delivering instruction, even if they were willing to practicing technology integration in the classroom. The finding was based on a mega project named *Open Learning Exchange Nepal* (OLE-Nepal), which was conducted in 26 academic institutions across six districts of Nepal. During the training period of the project, instructors were trained to enhance their technical competencies and were provided with the required technological resources for carrying out technology integration. This evidence highlighted that even if Nepalese instructors possess the technological resources, training, and willingness, which are necessary for technology integration in the classroom, their low level of competencies to create technology-integrated instructions are need to be addressed. Further, Wagle (2013) emphasized that technology need to be used as an effective instructional tool by instructors for enhancing the learners' learning, which should not be limited to simply enhancing the instructors' technical competencies.

The above discussions suggest that a developing country like Nepal may need further detailed guidance for instructors in creating and implementing technology-integrated instructions regardless of their technical competencies. Studies done by Bauer and Kenton (2005) and Mishra and Koehler (2006) also highlighted that instructors' high level of technical competencies is not enough for technology integration. Thus, in a developing country like Nepal, where efforts have been prioritized to provide technological resources and skill training to enhance instructors' technical competencies with the aid of international agencies, there is a need to urgently consider an applicable way to assist instructors in creating and implementing technology-integrated instructions for carrying out technology integration in the classroom.

In the literature, various models and framework have been discussed to assist instructors for implementing technology integration in the classroom such as (i) Instructional Design (ID) models, (ii) Technology Integration Model and Framework, and (iii) TPACK-based ID Models.

ID "is simply the process by which instruction is created" for classroom teaching including the various phases such as: analyzing, designing, developing, implementing, and evaluating to deliver a lesson plan (Carr-Chellman, 2015, p.3). ID models are a visualized narration of instruction that provides detailed guidelines to achieve defined instructional goals. The main purpose of ID models is to create comprehensive instructions for developing a required program, which does not necessarily need to be for technology integration. However, models like the *Analyze, State, Select, Utilize, Require, Evaluate, and Revise* (ASSURE) and Kemp's are still popular for designing and implementing technology-integrated instructions.

A study done by Darnawati, Jamiludin, Mursidin, and Yuniar (2016) in Indonesia revealed that instructors were incompetent in employing the ASSURE model in creating technology-integrated instructions for the classroom instruction because they lacked knowledge about the six-steps of the model and were also very anxious about using technology in the classroom. This emphasizes that instructors from a developing country like Indonesia lack the required competencies to utilize the ID model itself for technology integration. Further, Mustafina (2016) argued that in the context of developing countries, there are gaps between instructors' existing level of competencies compared with the required level needed to employ ID models in practice. Therefore, even if, ID models were offered in the context of developing countries, there are still some limitations such as (i) the need of expert guidance to utilize the various steps of ID models, (ii) the lack of instructors' awareness about ID models, and (iii) the increased time and financial burden to the educational institutions. Typically, general ID models help instructors to integrate technology into teaching but they still demand some level of instructors' competencies about the models themselves, which could hinder the instructors from using such models especially in the context of developing countries.

A *Substitution, Augmentation, Modification, and Redefinition* (SAMR) model and a TPACK framework were developed specifically for technology integration. Both the SAMR model and the TPACK framework specified the key procedures and key knowledge required by the instructors for technology integration. However, they also consist of few drawbacks such as (i) a SAMR model is very difficult to implement in practice because it lacks detailed guideline for instructors, and (ii) a TPACK framework also lacks a detailed structure for creating and implementing technology-integrated instructions by utilizing content, pedagogy, and technology simultaneously (discussed in Chapter 2).

Further, three TPACK-based ID models were also developed based on a TPACK framework for instructors of a Teacher Education Program (TEP): (i) a TPACK-*Comprehension, Observation, Practice, and Reflection* (TPACK-COPR) model by Jang and Chen (2010), (ii) a TPACK-*Introduce, Demonstrate, Develop, Implement, Reflect, and Revise* (TPACK-IDDIRR1) model by Lee and Kim (2014a), and (iii) a TPACK-*Introduce, Demonstrate, Develop, Implement, Reflect, and Revise* (TPACK-IDDIRR2) model by Lee and Kim (2014b). These models were developed to build competencies level of Preservice Teachers (PSTs) regarding TPACK in technology integration.

However, even if a TPACK-based ID model provides a new approach in technology integration to train the PSTs, it possess some limitations such as *the iterative characteristics,* which is a crucial element of the ID model. Unfortunately it was not practiced during an implementation of a TPACK-COPR model (Lee & Kim, 2014a, p.443). Similarly, TPACK-IDDIRR1 and TPACK-IDDIRR2 exclusively promote enhancing PSTs' competencies in terms of a TPACK framework. However, Chai, Koh, and Tsai (2010) revealed that having a high level of TPACK competency does not guarantee to bring technology integration in the classroom. Further, none of the above TPACK-based ID models provide detailed guidance that could assist TEP instructors (the term *TEP instructors* is used throughout the study in the place of Instructors in a TEP): (i) to utilize the various phases of the ID models and (ii) to create and implement technology-integrated instructions by offering a structure to consider content, pedagogy, and technology simultaneously. Even more, the development and implementation process of those models were limited within developed countries.

All in all, various models and frameworks discussed above lacking detailed guidance to assist instructors in creating and implementing technology-integrated instructions and do not provide sufficient support to carry out technology integration. Thus, the instructors might experience an extraneous cognitive load due to the added stress, time, and work required: (i) to follow the process of technology integration offered by those general models and framework and (ii) to create and implement technology-integrated instructions. Therefore, there is an urgent need for a new ID model to assist instructors in creating and implementing technology-integrated instructions to address the gaps found in the literature.

To address such gaps, a systems thinking approach has been employed to develop a new ID model to assist instructors in the creating and implementing technology-integrated instructions by addressing barriers to technology integration identified in the context of developing countries. A systems thinking approach refers to a process within the system dynamics to change "inputs and allow for interventions that can guide changes and improve outcomes" (Heinich, 1968; Rodriguez, 2013, p.12). Aronson (1998) explained that a systems thinking approach provides a platform for instructors to consider various elements of a system that affect other elements within the same system. Further, Picciano (2011) emphasized that this approach could be helpful in technology integration because instructors need to consider various elements to create and implement technology-integrated instructions.

A systems thinking approach has been applied in many studies to consider key elements of a system. A study done by Maddin (2012) discussed the approach in the context of technology integration to prepare instructors (n=16) and technology coordinators (n=2) for technology leadership in technology integration by incorporating three major elements including leadership and vision, learning and teaching, and assessment and valuation. By designing various modules, participants (instructors and technology coordinators) were trained to improve their leadership in technology integration. Further, based on their narrative reflections, participants were also trained to link multiple elements such as *the interest of learners, instructors and parents, technological resources and training available at schools, and their own attitudes toward technology integration.* In sum, the study done by Maddin (2012) clarified the importance of a systems thinking approach in technology integration because it highlighted the need to consider multiple elements simultaneously.

## Problem Statement

Studies revealed that developing countries suffer considerably from the first-order barriers to technology integration (technological infrastructures and trainings) because of issues related to national policies and funding, which are beyond the control of most instructors (Jhurree, 2005; Khan, Hossain, Hasan, & Clement, 2012). However, as discussed above in the Nepalese context, third-order barrier: creating a technology-integrated instrcution is the key hurdle to technology integration in the classroom instruction, which is termed as the instructors' competencies in the study (the term *instructors' competencies* is used throughout the study in the place of the instructors' knowledge and skills to create technology-integrated instructions).

Numerous studies revealed that instructors' competencies for technology integration could be improved with an appropriate technology integration model in a TEP to train PSTs (Dawson, 2008; Kirschner & Selinger, 2003; Stuart & Thurlow, 2000; Tearle & Golder, 2008; Tondeur, van Braak, Sang, Voogt, Fisser, & Ottenbreit-Leftwich, 2012). A study done by Stuart and Thurlow (2000) argued that PSTs need to be adequately trained for assisting instructors to carry out technology integration. Further, Hare, Howard, and Pope (2002, p.193) conducted a study with 26 PSTs to examine *a gap between what PSTs are taught about the technology integration* and *how they could implement those competencies to teach in the classroom*. The authors found that the PSTs trained with technology-integrated instructions had a high level of beliefs and confidence to integrate technology in the classroom instruction compared with those PSTs who were trained under as typical instruction.

As discussed by Chai, Koh, and Tsai (2010), Niess (2005), Tondeur, Pareja Roblin, van Braak, Voogt, and Prestridge (2017), TEP is a platform to educate future instructors to enhance the willingness as well as a competencies that required for carrying out technology integration in the classroom instruction. Among which, TEP also appears to be crucial for enhancing positive attitudes toward technology integration (Shirvani, 2014; Wang et al., 2004).

Studies done by Lee (2014), and Lee and Sparks (2014) in the Nepalese context, argued that even if Nepalese instructors had access to mobile phones, computers, and digital cameras, there are continued hurdles for technology integration. Based on the focus group interview with 27

Nepalese instructors and then follow-up individual interviews, the authors found that the instructors lacked enough competencies to create technology-integrated instructions for classroom instruction. Therefore, the authors suggested that the availability of detailed guidance could assist instructors to create and implement technology-integrated instructions, which could bring a significant improvement in carrying out technology integration. Similarly, Khan, Hossain, Hasan, and Clement (2012) also revealed that the instructors of developing countries require detailed structure in accomplishing the procedures that assist them to create technology-integrated instructions.

As discussed in the preceding paragraphs, existing ID models, SAMR model, TPACK framework, and TPACK-based ID models may not be sufficient for instructors in a developing country who often lack the competencies needed for creating and implementing technology-integrated instructions. In addition, Carlson and Gadio (2002) argued that instructors could experience an extraneous cognitive load because of lacking detailed guidance in creating and implementing technology-integrated instructions based on the available models and framework for technology integration. van Merrienboer and Sweller (2005) argued that an extraneous cognitive load could be alleviated by effective instructional interventions. One idea from a study done by Saravanan and Nagadeeps (2017) in India recommended that the extraneous cognitive load could be minimized by offering scaffolding process with *Worked Examples* for instructors.

*Worked Examples* are a kind of scaffolding consisting of a detailed set of guidelines for instructors to accomplish a task based on a demonstration (Atkinson, Derry, Renkl, & Wortham, 2000). As mentioned by Ayres and Sweller (2000), *Worked Examples* assist by addressing an extraneous cognitive load. Further, a study done by Mayer and Moreno (2003) suggested that

*Worked Examples* are effective instructional strategies for addressing an extraneous cognitive load that deals with learning and problem-solving difficulties. Even more, recently Chen, Woolcott, and Sweller (2017) recommended that *Worked Examples* are the strategies to minimize an extraneous cognitive load.

Recently, Saravanan and Nagadeeps (2017) conducted a study in India in a TEP with TEP instructors and PSTs to explore the barriers in technology integration. The authors found that the TEP instructors had experienced an extraneous cognitive load during technology integration because they had to spend additional time to create technology-integrated instructions. However, based on the findings of the study, most of the PSTs benefited from technology-integrated instructions having high engagement within the classroom. Thus, the authors suggested that *Worked Examples* could be an effective instructional strategy for addressing TEP instructors' extraneous cognitive load that could occur while creating and implementing technology-integrated instructions.

The problem which initiated this study was the need for a TPACK-integrated ID model to consider three key elements of technology integration as: content, pedagogy, and technology based on a systems thinking approach within a generic ID process to assist instructors in creating and implementing technology-integrated instructions for carrying-out technology integration during the classroom instruction. *Worked Examples* can be offered (i) to follow the process of a TPACK-integrated ID model and (ii) to create technology-integrated instructions. Thus, it is necessary to investigate how TEP instructors in a TEP could utilize a TPACK-integrated ID model through *Worked Examples* for technology integration in the classroom instruction. Further investigation needs to be carried out to understand the changes that could be found in the learning experiences of PSTs because of technology-integrated instructions carried out by TEP instructors based on a TPACK-integrated ID model through *Worked Examples*.

## Research Purpose and Questions

The purpose of this study was to develop and validate a TPACK-integrated ID model in a Nepalese context of a TEP to assist TEP instructors in creating and implementing technology-integrated instructions for carrying out technology integration. The TPACK-integrated ID model included *Worked Examples* to address an extraneous cognitive load of TEP instructors in (i) utilizing key phases and key components of a TPACK-integrated ID model, and (ii) creating technology-integrated instructions for classroom instruction.

After the development of a TPACK-integrated ID model based on a systems thinking approach, the study investigated how TEP instructors utilized a TPACK-integrated ID model through *Worked Examples*. It also examined changes in the learning experiences of PSTs in terms of engagement, learning outcomes, a knowledge transfer during teaching practice, self-efficacy toward technology integration, and attitudes toward technology for further improvement of a TPACK-integrated ID model and *Worked Examples*.

To achieve the targeted goal, this study addressed the following research questions:

1. What are key phases and key components of a TPACK-integrated ID model applying a systems thinking approach?
    a. What are key phases in a TPACK-integrated ID model for technology integration?
    b. What are key components that can be identified in a TPACK-integrated ID model?

2. How do TEP instructors implement a TPACK-integrated ID model for technology integration?

   a. How do TEP instructors utilize key phases and components of a TPACK-integrated ID model through Worked Examples?
   b. How do TEP instructors design and develop technology-integrated instructions for classroom instruction through Worked Examples?

3. What changes do occur in preservice teachers' learning experiences while implementing a technology-integrated lesson based on a TPACK-integrated ID model through Worked Examples?

   a) What changes occur in the engagement levels of PSTs?
   b) What changes occur in learning outcomes of PSTs?
   c) Is there any knowledge transfer during teaching practice?
   d) What changes occur in self-efficacy beliefs regarding technology integration of PSTs?
   e) What changes occur in attitudes toward technology of PSTs?

## Definitions of Terms Used in the Study

### Extraneous Cognitive Load

Extraneous Cognitive Load refers to any situation that distracts and causes difficulty because of having too much work to achieve teaching objectives (DeJong, 2010, p.107). Poorly designed instruction accounts for an extraneous cognitive load.

### Instructional Design Model

An Instructional design (ID) model is a roadmap or guideline to design and develop instruction (Lim & Chai, 2008, p. 2009). In the study, the main purpose of the ID model is to help TEP instructors in carrying out technology integration in the classroom instruction.

### Teacher Education Program

A Teacher Education Program (TEP) is a university undergraduate degree termed as B.Ed. (Bachelors of Education) taken by preservice teachers to be a qualified instructor in the future.

### Teacher Education Program Instructor

A Teacher Education Program Instructor (TEP Instructor) stands for faculty in the Teacher Education Program who educates preservice teachers.

### Preservice Teachers

Preservice Teachers (PSTs) are university students enrolled in the Teacher Education Program to be qualified instructors for K-12 in the future.

# Chapter 2: Literature Review

The purpose of this chapter is to review the literature on technology integration in education and identify the research gap in the existing studies. This chapter covers (i) concepts and purpose of technology integration, (ii) barriers to technology integration, (iii) existing models and framework for carrying out technology integration, and (iv) theoretical background and conceptual framework of the study. This chapter also discusses the development of a TPACK-integrated ID model for the pilot study.

## Concepts and Purpose of Technology Integration

Quality education was considered as one of the top-four agenda items among the 17 Sustainable Development Goals of the United Nations (United Nations, 2017). Whitaker (2017) elaborates that technology is central as an instructional tool to achieve the quality education that justifies the necessity of technology integration. With the rapid development of technology and its growing application in the educational environment, the twenty-first century education needs to address the demand of learners from diverse contexts and backgrounds. As argued by Oosthuizen (2016, p.1), the "education system could become irrelevant if the educational gap between how learners live and how learners learn is not filled". Thus, technology integration in classroom instruction needs to be re-considered because technology is already an integral part of many learners' lives in the twenty-first century (Clements & Sarama, 2003; Haugland, 2005; McKenney & Voogt, 2012; Parette & Blum, 2013; Prensky, 2008; Yelland 2005).

As defined by the International Society for Technology in Education, technology integration is an infusion of technology as a tool to enhance learning in multidisciplinary content settings (Fish, 2011). Further, technology integration is the process of utilizing various kinds of technological tools and skills to strengthen and support the educational environment. In addition, it possesses multiple purposes such as: to reinforce topics in terms of class lectures, to gather more information for report writing by using the online databases, and to implement social media for instant feedback (Bajracharya, 2017; King & Sen, 2013). However, the crucial intent of technology integration is to enhance purposeful learning based on the objectives of the course. As discussed in Chapter 1, technology integration in this study consists of content, pedagogy, and technology as the three major elements.

Furthermore, studies done by Kulik (2003) and Webb and Cox (2004) revealed that technology integration enhanced the learners' construction of knowledge that leads to the enhancement of learning outcomes. Similarly, based on the constructivism approach, the purpose of technology integration is to enhance interactions among *learners to learners*, *learners to instructors,* and *instructors to learners* for the creation of knowledge (Willis & Tucker, 2001, p.18). This can occur because technology integration provides a platform for individuals and groups "to learn socially and culturally" (Pittman & Gaines, 2015, p.540). Even more, as argued by Jones (2009, p.23), learners' engagement is "one of four dimensions of the learning criteria for the twenty-first century" that could be achieved in technology-integrated classrooms. Therefore, the most important and common purpose of technology integration is to engage the learners in achieving purposeful learning outcomes.

Studies carried out by Gulbahar (2007), Teo (2009) and Ward and Zhou (2006) argued that the purposes of technology integration stand for accessing educational resources, motivating learners for learning and assisting instructors in addressing their extraneous cognitive load while delivering instruction in the classroom. Similarly, UNESCO (2008) reported that technology integration needs to be practiced in educational settings for promoting and enhancing the teaching and learning. As discussed above, there are multiple benefits in implementing technology integration during classroom instruction. However, three major barriers in bringing out technology integration was also discussed below.

## Barriers to Technology Integration

As discussed by Brickner (1995), Ertmer (1999), and Tsai and Chai (2012), there are three types of barriers to technology integration such as (i) first-order, (ii) second-order, and (iii) third-order. First-order barriers are external factors consisting of resources, access, institutional support, and training which could be eliminated by securing additional resources and training. However, as found by Handley and Sheingold (1993) and Parks and Pisapia (1994) technology integration is not carried out in everyday teaching and learning process, even though millions of dollars are invested for additional technological resources and training. These results highlighted that the elimination of first-order barriers does not ensure successful technology integration during classroom instruction.

Similarly, the second-order barriers are personal beliefs, which are more instructor-centered and relate to the instructors' attitude toward technology integration, which is the main cause for the willingness to adopt technology in the classroom instruction. As reported by Shirvani (2014) and Wang, Ertmer, and Newby (2004), the instructors' self-efficacy toward technology integration and attitude toward technologies are responsible for the instructors' attitudes toward technology integration.

As defined by Bandura (1995, p.2), self-efficacy is a "person's belief in their capabilities to organize and execute the courses of action required to manage prospective situations". Mishne (2012) added that instructors' self-efficacy stands to what extent instructors believe in themselves about their capacity to affect the learning experiences of their learners. Empirical evidence shows that instructors with a high self-efficacy also do have greater enthusiasm and commitment towards teaching (Allinder, 1994; Coladarci, 1992). Further, Albion (2001) argued that instructors with a low level of enthusiasm in technology integration used fewer technologies in the classroom instruction; and they also possessed a low level of confidence in their capacity, even when they were knowledgeable and skillful in utilizing technology. Instructors' self-efficacy toward technology integration is, therefore, a major factor that affects instructors' attitude toward technology integration.

Furthermore, Chen (2008) and Wozney, Venkatesh, and Abrami (2006) argued that instructors' attitude toward technology also another crucial factor responsible for carrying out technology integration in the classroom instruction. A study conducted by Drent and Meeliseen (2008) among 210 instructors revealed that instructors' attitudes toward technology are a major barrier for practicing technology integration in the classroom. After conducting a survey and then in-depth interview with four instructors, Drent and Meeliseen (2008) concluded that even if, instructors know about the necessity of technology integration, their attitude toward technology plays a vital role in carrying out technology integration in practice. Similarly, studies were done by Mustafina (2016), Koohang (1989), Lawton and Gerschner (1982) supported the fact that instructors' attitude toward technology influences their attitude toward technology integration. Based on the studies discussed above, instructors' self-efficacy and attitude toward technology are considered to be two major factors that have a significant impact on instructors' attitude toward technology integration, which are considered to be second-order barriers to technology integration.

In a review, Tsai and Chai (2012) show that technology integration has not been practiced in the classroom instruction even if first-order and second-order barriers are addressed. Thus, the authors argued that instructors' competencies for designing and developing technology-integrated instructions need to be developed to carry out technology integration in the classroom instruction. Furthermore, Lim and Chai (2008) also claimed that instructors need to aware of utilizing available technological resources in a meaningful way. Therefore Lim and Chai (2008) emphasized that instructors' competencies for designing and developing technology-integrated instructions are crucial for implementing technology integration.

Since the third-order barriers are related to instructors' competencies, this requires urgent action especially in the developing countries because of the remarkable efforts from both national and international organizations that have invested millions of dollars for technological resources and technical training. Thus, assisting instructors' competencies for designing and developing technology-integrated instructions could facilitate carrying out technology integration during classroom instruction.

Research has identified that instructors' diverse instructions and guidelines for technology integration in the classroom are based on the different models and framework. Gustafson and

Branch (1997) revealed that the utilization of such models and framework is rooted in practicing technology integration in the classroom depending on the needs of the courses. However, studies show that instructors from developing countries have difficulties with utilizing those models and framework because of lacking (i) their competencies in using those models and framework and (ii) detailed guidance to design and develop technology-integrated instructions (Carlson & Gadio, 2002; Saravanan & Nagadeeps, 2017). As found by DeJong (2010) and van Merrienboer and Sweller (2005), such obstacles could cause an extraneous cognitive load among instructors during the utilization of models and a framework for carrying out technology integration.

An extraneous cognitive load is identified as a type of cognitive load which is primarily concerned with the total amount of mental effort being used in the working memory (Pass, Renkl, & Sweller, 2003). An extraneous cognitive load is associated with cognitive processes, which does not directly contribute to the learning and which could be altered by instructional interventions (van Merrienboer & Sweller, 2005). As found by Ayres and Sweller (2005), *Worked Examples* could be an effective instructional strategy to address such extraneous cognitive load experienced by instructors.

*Worked Examples* is a "step by step demonstration of how to perform a task or how to solve a problem" (Clark, Nguyen, & Sweller, 2011, p.190). It is an effective instructional strategy for teaching complex problem-solving skills (van Merrienboer, 1997). The structure of *Worked Examples* provides detailed guidance to instructors for problem-solving through the observation of examples which are known to be useful for novice instructors that lack prior competencies (van Gog & Rummel, 2010; van Merrienboer & Sweller, 2005). In this study, *Worked Examples* was offered based on a TPACK-integrated ID model for TEP instructors: (i) to follow the process of a TPACK-integrated ID model and (ii) to provide a structure for designing and developing technology-integrated instructions that was based on Gagne's nine events of instruction.

## Instructional Design

Instructional Design (ID) is a procedure for developing an educational or training program, curricula, or courses in a sequential and authentic manner (Branch & Merrill, 2011, p. 8). This procedure enables instructors to create instructions that involves the "systematic planning of instruction" (Smith & Ragan, 2005, p.8), ranging from instructional analysis to evaluation (Mager, 1984). It can also be referred to as a "systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation" (Smith & Ragan, 2005, p.4). These definitions explored that ID is a framework which provides the process to create the instructions based on the necessity of a teaching and learning environment. Thus, ID can be defined as a process to develop directions and specifications using learning and instructional theory to ensure the quality of instruction.

ID has also been perceived as both a science and an art to creating instructions from the planning to the evaluation stages in which revisions can be made after implementation of the program (Carr-Chellman & Reigeluth, 2009, pp 5-9). Science and the arts are both core concepts of ID and are useful in creating and implementing instruction, a complicated process involving human ingenuity, software and hardware components (Piskurich, 2006, p.3). Essentially, ID is all about a set of rules constituting a chronological process. For instance, development of a training program involves a series of methods such as analyzing, designing, developing, implementing, and evaluating to create quality learning experiences and environments. In summary, the primary goal of the ID process is to generate the instruction to achieve the objectives of the program and training.

## Instructional Design Models

There are many ways to design instructions depending on the needs and nature of the program and training. For example, ID for teaching in a K-12 classroom will most likely be different from the type intended for delivering instruction online and so on (job-training, army training, etc.). According to Smith and Ragan (2005, p.10), "models may be defined as visualized depictions of an instructional design process, emphasizing main elements and their relationships", which provide guidelines for organizing and structuring the process of creating instructional activities. Gustafson and Branch (2002) categorized ID models into three groups such as classroom-oriented, product-oriented, and system-oriented.

Classroom-oriented ID models are a roadmap or guideline to improve the teaching and learning experiences in the classroom and are considered as potential models for designing technology-enhanced learning instructions (Lim & Chai, 2008). Models, such as ASSURE, and Kemp fall under this category. Accordingly, product-oriented ID models aim to develop an instructional product used in the context of self-learning environments or e-learning (Gustafson & Branch, 2002; Johnson, 2009). Tony Bate's Actions model is an example of a product-oriented ID model. Finally, a system-oriented ID has been regarded as a high-level model for the development of a course or curriculum. Different from the classroom and product-oriented ID models, a system-oriented ID model focuses on the goal of the organization before the development of instruction. The Instructional Project Development and Management model belongs to this category where every component needs to be broken down into different forms for carrying out a needs analysis.

Previously, ID models had been continuously used in the corporate world especially to design staff training programs in the military. With the passage of time, the implementation of ID models shifted to educational settings and began to be considered as a useful methodology for classroom instruction (Moore & Knowlton, 2006). Based on the scale or size of the program, ID models can be divided into two groups and classified into macro and micro. Macro ID models are concerned with the designing of an entire program (Surry & Farquhar, 1997). ADDIE, ASSURE, Dick and Carey, Hannafin and Peck, Gilly Salmon are few examples of macro models. Similarly, ID models used to design a single lecture or teaching session are known as micro ID models. Gagne’s nine events of instruction and Elaboration theory are two examples.

As discussed above, there are various types of ID models to design and develop an instruction based on the nature and scale of the program. However, the necessary steps in most of the ID models contain five key phases: *Analyze, Design, Develop, Implement, and Evaluate,* which are also known as the ADDIE model (Piskurich, 2006). ADDIE is a systematic ID model that follows the generic process to create instruction. Cost-effectiveness, time usage, active learning, and classroom-orientedness are some of the merits of the ADDIE model.

Among the five phases of ADDIE, *Analyze* is the initial phase that deals with the learning environment including information about learners and educational institutions. The second phase is *Design,* which is concerned with the learning objectives, lesson plans, and assessment of instruments. It needs to be systematic and specific to achieve the learning goals. Thirdly, in the *Develop* phase, the required materials and contents are created based on the *Design* phase. The fourth phase is *Implement* where created materials are utilized during classroom instruction. Finally, *Evaluate* consists of tests for obtaining feedback and reviewing developed lesson plans and materials. ADDIE was originally considered to be a linear ID model, but each phase was found to be highly interrelated and was cyclic (van Merrienboer, 1997).

### ASSURE Model

**Overview.** ASSURE is a procedural, cyclic, and classroom-oriented ID system model to design and develop technology-integrated instructions. It was developed by Heinich, Molenda, Russel, and Smaldino in 1996. It is an acronym that stands for the six steps in the model. Figure 2.1 represents the ASSURE model consisting of the six steps discussed below.

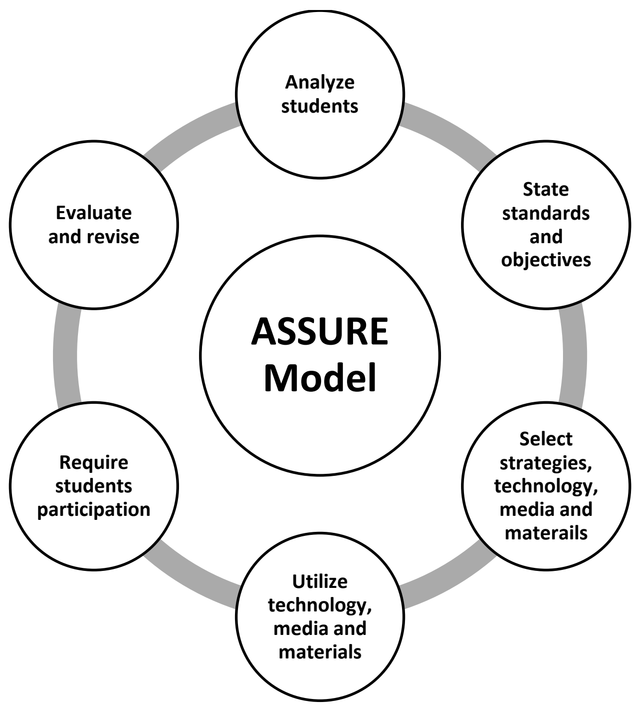



*Figure: 2.1* ASSURE model
Source: Heinich et al., 1996, p. 248

The initial letter, *A* stands for *Analyze* learners, instructors need to know their learners and that data should not only be limited to personal information and demographics but should also include learners' general characteristics, specific entry competencies, and learning styles.

Instructors were required to be aware of the knowledge and skills possessed by their learners before classroom instruction.

Second, *S* stands for *State standards and objectives* to know the expected learning outcomes that instructors should understand before delivering the instruction. Based on the field and the nature of the subject, planned learning experiences are different. Thus, it is an instructor's responsibility to have clear standards and objectives, to decide content and methods, to provide guidance, and to achieve an expected outcome. A good set of learning objectives could be offered based on an approach, which is termed as ABCDs that stands for: *Audience* (to whom the goal is intended), *Behavior* (to what extent learners will learn after instruction), *Condition* (to what conditions under which the behavior could be observed), and *Degree* (to what extent learners will gain competencies/ or knowledge and skills).

Third, *S* stands for *Select strategies, technology, media, and materials*. It refers to various instructional strategies consisting of learner-centered, instructor-centered, collaborative, and many more. Further, this also applies to the selection of multiple technologies and media based on the objectives relevant to the course content. For instance, technological resources such as an *Interactive White Board* could be a useful tool for a collaborative learning environment during classroom instruction.

Fourth, *U* stands for *Utilize technology, media, and materials,* which concerns to the utilization of selected technological resources to create technology-integrated instructions for achieving an objective and learning outcomes. To create such instructions, Smaldino, Lowther, and Russell (2008) offered 5Ps consisting of: (i) preview the materials – plan in advance to know how to utilize all the materials including rehearsal to make sure that classroom instruction could be delivered smoothly and seamlessly, (ii) prepare the materials – gather all the required materials for classroom instruction (collect all the information such as texts, graphics, videos etc.), (iii) prepare the learning environments – allocate the required space including enough desks and so on, (iv) prepare the learners – provide the detailed information about the syllabus that includes: learning objectives, required assessments, grading policies, and so on, and (v) provide the learning experience – putting all the plans into action during classroom instruction.

Fifth, *R* stands for *Require learner participation,* which relates to the engagement of learners in the classroom and which requires instructors to utilize materials during classroom instruction. Various learning approaches such as *learning by doing* and *vicarious learning experiences* are some of the approaches for enhancing learners' active participation in classroom instruction. Further, various pedagogical strategies could be practiced by instructors to provide opportunities for learners' participation.

Finally, *E* stands for *Evaluate and revise*, which includes an evaluation of the learners' achievement and lesson plans (objectives, strategies, technology, media, materials, and so on) and for further improvement. As discussed above, the six phases of ASSURE model demonstrate how to select, implement, and evaluate the technology and instructional resources for carrying out technology integration during classroom instruction to achieve the learning objectives. To elaborate on the implementation of the ASSURE model few studies are discussed below.

**Studies.** A study conducted by Baran (2010) implemented the ASSURE model to investigate the learning outcomes in Turkish university learners. An Interactive White Board was used to deliver a technology-integrated lesson during classroom instruction. The study was qualitative with 40 university learners, among which 13 were female, and 17 were male. The findings of the study revealed that technology-integrated instructions, which was based on the ASSURE model, enhanced the learners' interaction and participation during classroom instruction. Although a high level of learners' participation was achieved, the instructors were exhausted because they lacked detailed guidance for creating a technology-integrated lesson and they also experienced an extraneous cognitive load because of investing such a large effort to utilize the ASSURE model. Based on the evidence discussed above, ASSURE could be considered to create a technology-integrated instruction; however, because of lacking detailed guidance, the instructor could experience difficulties in utilizing it.

Further, Darnawati, Jamiludin, Mursidin, and Yuniar (2016) utilized the ASSURE model in an Indonesian high school to teach history. As explained by the authors, previously learners were not engaged in the classroom because history class was perceived as a boring subject among learners, and they preferred memorizing the content to pass the exams. Thus, this study was carried out to engage learners during classroom instruction. To offer a procedural guide in creating the lesson plans, six phases were followed from *Analysis* to the *Evaluate* of instructions. Experts from media and learning material were assigned to assist the instructor in utilizing the ASSURE model in their classroom instruction because of the instructor's lack of competency about the model. The findings of the study revealed that technology-integrated instructions was successfully created by instructors after receiving support from the two experts. However, the study highlighted that an instructor might not be able to utilize the ASSURE model if they are not aware that such model exists in the first place. Such findings were also found by Sezer, Karaoglan Yilmaz, and Yilmaz (2013).

**Weakness related to technology integration.** ASSURE is a procedural ID model that is helpful in creating technology-integrated instructions that incorporates various technologies, media, and materials. However, based on the studies discussed above, few drawbacks of the ASSURE model were revealed. First, in the context of developing countries, instructors might not be aware of such an ID model, which could hinder its utilization during classroom instruction. Further, as revealed by Horst (2016), developing countries lack enough instructors and a limited number of instructors need to teach many classes. Thus, in such circumstances, instructors were not able to utilize various procedures of ASSURE model with in short span of time because of lacking detailed guidance, even if the ASSURE model provides procedures for creating technology-integrated instructions. In such contexts, hiring an expert could be a heavy economic burden in the context of developing countries.

**Kemp's Model**

**Overview.** Kemp's model is also termed as the Morrison, Rose, and Kemp model, which represents innovation to the instructional design by its non-linear structure and the interrelated nature of its components (Morrison, Ross, Kemp, & Kalman, 2010). Figure 2.2 represents the graphical diagram of Kemp's model which has nine phases in the form of an oval that reflect the designing process as cyclic. Based on Morrison et al. (2010), those nine phases stand for: (i) instructional problems – to specify the goals and to identify the potential issue, (ii) learners' characteristics – to examine the learners' characteristics based on the instructional decisions (iii) task analysis – to clarify the course content and analyze whether it is related to goals and purposes, (iv) instructional objectives – to specify the objectives of instructions, (v) content sequences – to arrange units of instructions in logical and sequential order for learning, (vi) instructional strategies – to master the objectives of a lesson; (vii) designing a message – to plan and develop an instruction, (viii) development of instruction – to select instruction and learning activities, and (ix) evaluation instruments – to measure the objectives of the course.

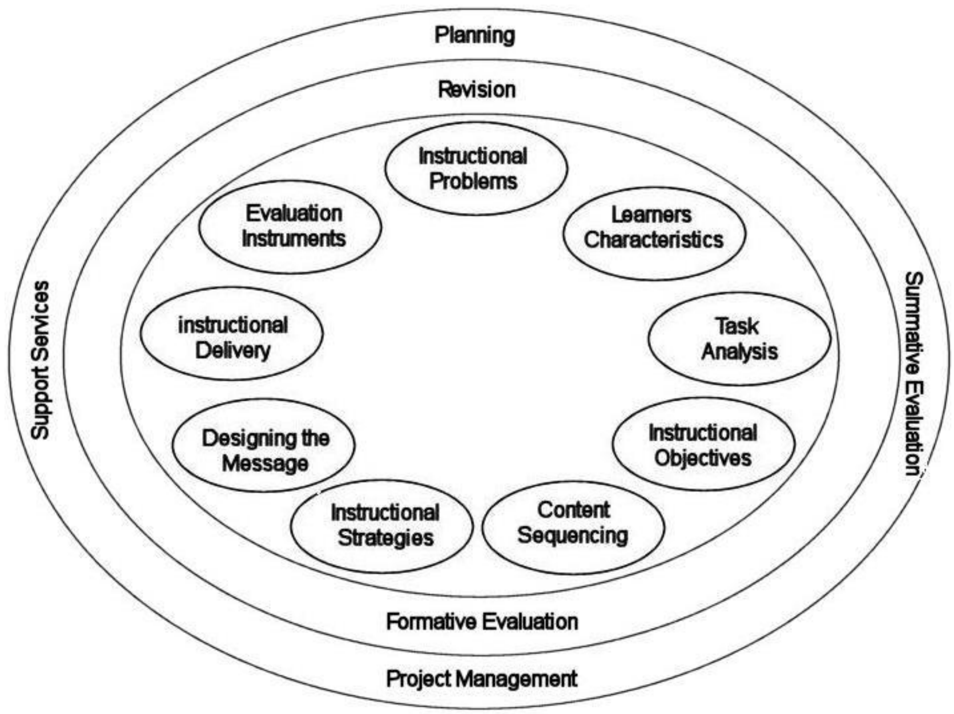



*Figure: 2.2* Morrison, Ross and Kemp's model
Source: Summerville and Reid-Griffin, 2008, p. 47

In contrast with an ASSURE model, all nine phases of Kemp's model are not interrelated with each other which allows instructors to begin from any phase. Since instructors could initialize from any phase, flexibility has been considered as an important characteristic of the model. This model consists of a few significant aspects because none of the nine phases were inter-dependent and entire phases could be performed simultaneously. Summerville and Reid-Griffin (2008) revealed that instructors' pedagogical strategies could be comfortably accommodated in the model, although it might not help in the transfer of knowledge. Thus, it is difficult to integrate technology in planning the instructional tasks.

Since Kemp's model is macro, it focuses on the development of a curriculum rather than on a single instructional instruction. During an implementation process of the model, instructors could begin with six questions that relate to the skills and knowledge to be learned. Such questions are: (i) required level of learners' readiness, (ii) instructional strategies, (iii) suitable media for the contents and learners, (iv) level of learners' support, (v) measurement of achievement, and (vi) strategies to conduct formative and summative evaluations (Morrison et al., 2010). This model does have a significant effect on the development of a whole course compared with a single lesson. During this process, it is impossible to overcome the obstacles related to the administrative support which is an integral part of the design and development process, which might be considered as a drawback of Kemp's model. To elaborate its implications and obstacles in technology integration, a study is discussed below.

**Study.** Caliskan (2014) employed a qualitative approach to investigate instructors' perception of ID models for preparing lesson plans and implementing them during classroom instruction. The study consisted of 12 instructors who taught science. The findings of the study revealed that the instructors' experiences regarding Kemp's model were satisfactory because of its flexibility and that they could easily justify the plans for making possible changes related to the planning process.

**Weakness related to technology integration.** Morrison et al. (2010) acknowledged that some educational projects might require all the nine-phases that provide flexibility for instructors to begin with the required phase. However, Botturi, Cantoni, Lepori, and Tardini (2006) argued that since the design is nonlinear, it might demand instructors' knowledge and skills to use the Kemp's model. Thus, instructors from developing countries could experience difficulties to create a technology-integrated lesson for classroom instruction.

Studies discussed above regarding the ASSURE and Kemp's model revealed that instructors from the developing countries still need support from experts to utilize such ID models to create technology-integrated instructions. Moreover, ID models are very time-consuming processes which hinders their use, especially in the developing countries where instructors have to teach many classes.

## Technology Integration Models and Framework

The primary objective of technology integration is to transform the knowledge shared during classroom instruction. To carry out that transformation, the following technology integration models and framework are discussed.

### SAMR Model

**Overview.** SAMR is a model developed to assist in integrating technology for classroom instruction. As defined by Hunter (2015, p.49), it "focused on explaining how instructors can consider technology integration in classroom teaching". SAMR is an acronym that stands for the four steps in the model developed by Puentedura (Puentedura, 2006). Figure 2.3 illustrates the SAMR model, with the initial letter *S* that stands for *Substitution,* which means that technology acts as a direct tool without functional changes. At this step, new technology could be utilized instead of old technology. The second letter *A* stands for *Augmentation,* where technology acts as a direct tool for functional improvement. Third, *M* refers to *Modification,* where technology allows for the redesigning of the task for significant enhancement of instruction. Finally, *R* stands for *Redefinition,* where technology allows for creativity in creating new functions. Among the four steps of this model, the initial two steps (*S* and *A*) are considered as enhancement and the final two (*M* and *R*) as transformation. The SAMR model supports and enables instructors to design and develop a lesson plan by infusing new technological tools. The major goal of the model is to enhance the learners' learning achievements. To illustrate an implication of a model, few studies are discussed in the following section.

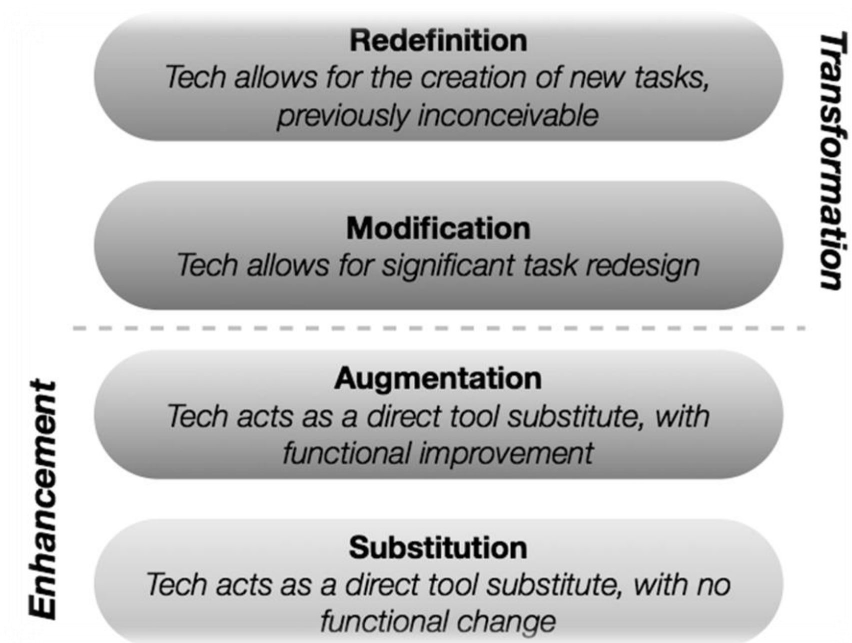



*Figure: 2.3* SAMR model
Source: Hunter, 2015, p.49

**Studies.** To maximize the learning potential of elementary school learners, Melissa and Heather (2013) used smartphones for educational applications and relevant educational websites. The authors had employed the four steps of the SAMR model to enhance the teaching and learning experiences of learners. In this study, learners were asked to use the educational application named *Quicklyst* for taking notes instead of using paper and a pencil. Further, learners were allowed to use smartphones in the classroom for note taking and were also permitted to share among the other learners for the enhancement of collaborative learning. Even more, learners were asked to create new ideas based on the classroom instruction that they had received in the class such as the creation of animation and so on. This is how the authors integrated new technologies in accordance with the four steps of the SAMR model. The findings of the study revealed that the advancement of the technological tools enhances the learning experiences. However, the study still contains many issues such as the technical competencies of instructors and learners, and the effectiveness of new technologies compared with an old technology.

Jude, Kajura, and Birevu (2014) conducted a study in Uganda for carrying out technology integration in the classroom instruction. Based on the instructors' experiences regarding the use of the SAMR model, they found that four steps were very complicated to follow, even if, their pedagogical strategies resulted in improvement. Replacement of old technologies with new ones was not straightforward and needed detailed guidance to utilize those steps for carrying out technology integration during the classroom instruction.

**Weakness related to technology integration.** As argued by Linderoth (2013), even if, SAMR has been practiced for technology integration in the classroom instruction, it still lacks an established theoretical background, which needs to be investigated further. Even more, apart from the perspective of theory, the four steps of SAMR could create technology integration in the classroom instruction. However, the use of detailed guidance for instructors to utilize those four steps has not been investigated yet. Thus, instructors could experiences difficulties in technology integration as discussed above.

### TPACK Framework

**Overview.** A TPACK framework builds on Shulman's (1986) concept of PCK to explain how instructors' Technological Knowledge and PCK interact to carry out technology integration in the classroom instruction. This framework provides a visualized perspectives of the three major pieces knowledge required by instructors for technology integration.

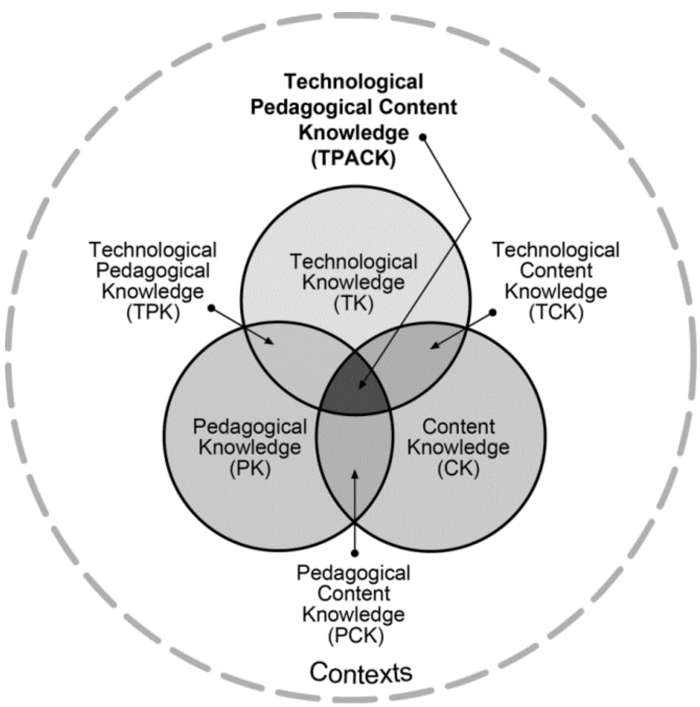



*Figure: 2.4* TPACK framework
Source: Koehler, and Mishra, 2008, p.16

**Technology pedagogy and content knowledge.** TPACK stands for the Technological Pedagogical and Content Knowledge which is required by instructors for carrying out technology integration and was based on content, pedagogy, and technology (Haris, Mishra, & Koehler, 2009; Jang & Tsai, 2012; Mishra & Koehler, 2006). It provides the three specific elements that instructors could consider in technology integration during classroom instruction: *content* (knowing the subject matter), *pedagogy* (understanding how to teach), and *technology* (knowing technological tools and its applications). Figure 2.4 represents a TPACK framework that comprises seven different forms of knowledge established after the intersection of three specific kinds of knowledge as *Content Knowledge, Pedagogical Knowledge, and Technological Knowledge*.

**Content knowledge.** *Content Knowledge* (CK) is the instructors' knowledge about the course matter including curricular knowledge (Mishra & Koehler, 2006). It includes the instructors' concepts, theories, ideas, and evidence (Shulman, 1986). It is one of the three main specific pieces of instructors' knowledge regarding discipline and relevant contents. For instance, knowledgeable instructors of content could broaden a classroom instruction into real-life situations to help the learners connect with the material.

**Pedagogical knowledge.** *Pedagogical Knowledge* (PK) is the instructors' knowledge about instructional strategies that includes intensive competencies about the practices (Koehler & Mishra, 2008). Pedagogy is the science of teaching and consists of various techniques, and instructional strategies utilized during classroom instruction to enables learners to learn. It is also one of the three main specific areas of knowledge. Further, Koehler and Mishra (2008) explained that instructors with PK could utilize relevant instructional strategies during classroom instruction to further enhance the learners' learning regarding content. Mishne (2012) argued that PK is also part of the professional body of knowledge that assists in understanding the process of delivering instruction.

**Technological knowledge.** *Technological Knowledge* (TK) is the instructors' knowledge of technological tools, programs, and its applications. Since technology is always changing and updating, Mishra and Koehler (2006) found that instructors could experience difficulties to master their TK because of rapid transformation. It is one of the main areas of knowledge about TPACK that was added into Shulman's PCK, which represents "individual tools or techniques, and all tools and techniques and knowledge" (Mishra & Koehler, 2006, p.5). It refers to the instructors' knowledge about relevant and recent technologies such as internet, videos, smartphones, applications, Bluetooth, social media, online learning tools, and many more. It also includes computer skills including word processing, Excel, PowerPoint, etc. If the instructors have a good understanding of TK, they can have better options for technology integration. Instructors could also take advantage of the available technologies to enhance the learning and prepare the learners for the twenty-first century. Further, the instructors' attitudes toward technology makes a significant impact on utilizing technology during classroom instruction.

**Pedagogical content knowledge.** *Pedagogical Content Knowledge* (PCK) is the most crucial knowledge that is associated with the instructors' instructional strategies to deliver the required content. As reported by Koehler and Mishra (2008), quality teaching is about the transformation of content with the adaptation of relevant pedagogical strategies regarding the material.

**Technological content knowledge.** *Technology Content Knowledge* (TCK) is a combination of TK and CK. As explained by Mishra and Koehler (2006), TCK is the understanding of how technology and content influence and constrain each other. The key concept of TCK is to represent content matters effectively with the adoption of appropriate technological applications. Thus, instructors with TK could deliver the required content. For instance, the implementation of educational software named Geometer's Sketchpad to provide a better conceptual understanding of geometry is an example of using TCK.

**Technological pedagogical knowledge.** *Technological Pedagogical Knowledge* (TPK) is about how teaching and learning changes when technologies are used (Mishra & Koehler, 2006). It is important to know the strengths, constraints, and affordances of the technologies before designing and developing technology-integrated instructions. Instructors could examine various pedagogical strategies before considering any technologies for classroom instruction to achieve the learners' learning experiences such as engaging learners in the classroom and enhancing their learning outcomes.

**Studies and weaknesses related to technology integration.** Recently, a study conducted by Dalal, Archambault, and Shelton (2017) utilized a TPACK framework among instructors from developing countries. To investigate the instructors' competencies regarding TPACK and to create technology-integrated instructions, the authors employed a mixed-method research design including surveys and interviews. After the semester-long course, the findings of the study revealed that even if instructors' competencies regarding TPACK had improved they still found difficulties to create technology-integrated instructions for classroom instruction. Further, interview data revealed that even if instructors were competent in content, pedagogy, and technology, they were not able to create technology-integrated instructions after being trained to use a TPACK framework. Thus, the authors concluded that having a high level of the instructors' knowledge of TPACK could not guarantee the enhancement of their competencies for carrying out technology integration. This was because TPACK lacks the structure to create technology-integrated instructions. Further, Padmavathi (2016) argued that a TPACK framework requires detailed information to create technology-integrated instructions. Thus, based on the evidence discussed above, a TPACK framework is not sufficient for creating technology-integrated instructions to integrate content, pedagogy, and technology simultaneously.

### TPACK-based Instructional Design Models

Despite having models including ID and SAMR, a TPACK framework has been increasingly utilized for technology integration in the classroom instruction. As argued by Kopcha, Ottenbreit-Leftwich, Jung, and Baser (2014), a TPACK framework is becoming popular because it provides three specific elements, which need to be considered by instructors for carrying out technology integration. To provide a systematic ID model based on a TPACK-framework, three TPACK-based ID models are also developed. The key focus of those models was to enhance the TPACK level of PSTs. Three TPACK-based ID models are developed for a TEP with an objective to train PSTs during which TEP instructors delivered a technology-integrated lesson based on a TPACK-based ID model.

**TPACK-COPR model**. Jang and Chen (2010) developed a TPACK-based ID model for enhancing TPACK competencies of PSTs in the science curriculum. The authors had developed a TPACK-COPR model based on PCK, a TPACK framework, and peer coaching as a theoretical background. This model includes four major phases such as TPACK-*Comprehension* (*C*), *Observation of instruction* (*O*), Practice *of instruction* (*P*), and Reflection *on TPACK* (*R*). Jang and Chen (2010) implemented a TPACK-COPR model in a science course in a TEP for 18 weeks, which was scheduled for two hours every day. The key purpose of this model was to enhance the competency level of TPACK among PSTs. During the intervention period, PSTs were assigned to understand a TPACK framework, which improved the technical competencies of PSTs and its application for the initial four weeks. Then, PSTs observed a TPACK-based classroom instruction provided by the experts for two weeks. Further, PSTs practiced a TPACK framework for nine weeks by designing and developing a TPACK-based lesson plan. In this phase, PSTs learned to make a lesson plan for classroom teaching. Finally, the reflection was carried out for three weeks to receive feedback from the experts. The findings revealed that the four phases of a TPACK-COPR model offered possible opportunities for PSTs for designing and developing a lesson plan in the science course. However, based on the reflection notes, PSTs had experienced difficulties in integrating content, pedagogy, and technology in creating technology-integrated instructions. This implies that PSTs with a high level of TPACK do not necessarily have sufficient competencies to design and develop a technology-integrated lesson plan on their own.

**TPACK-IDDIRR1 model.** TPACK-IDDIRR1 is a procedural ID model developed by Lee and Kim (2014a), and stands for *Introduce* - TPACK, *Demonstrate*, *Develop*, *Implement*, *Revise* - a TPACK - based lesson, and *Reflect* on a TPACK-based lesson. The purpose of this model was to develop an ID model for TEP instructors to train PSTs in a TEP, during which PSTs were taught to enhance their TPACK competencies in multidisciplinary courses for carrying out technology integration. Among the six phases, the initial two were carried out by the TEP instructors to provide the concept of a TPACK framework and demonstrate a TPACK-based lesson for PSTs. After that, the remaining four phases were performed by PSTs. Except for the developmental phase, the implement, revise, and reflection stages were carried out multiple times to enhance the competencies of PSTs regarding a TPACK framework. The model was based on the TPACK, learning by design approach, and ID models for technology integration as a theoretical foundation.

**TPACK-IDDIRR2 model.** TPACK-IDDIRR2 is an elaborated version of TPACK-IDDIRR1. This model is also a procedural ID model developed by Lee and Kim (2014b), which was divided into three steps. Step 1 focused on how to understand a TPACK framework including an initial phase as *Introduction* of TPACK by TEP instructors that provides TPACK teaching examples, in which PSTs explored, discussed, and created TPACK examples and its related domains. Secondly, step 2 involved engaging in TPACK activities, and consisted of three major phases: *Develop*, *Reflect on,* and *Revise* and Gain feedback. In this step, PSTs were engaged in a TPACK-based instruction with three different types of technologies for three times. Finally, step 3 was to practice TPACK that included four major phases consisting of *Develop*, Gain feedback, *Implement*, and *Reflect* on and *Revise*. In both the steps, a *learning TPACK by design approach* was practiced similar to the TPACK-IDDIRR1 model.

**Weaknesses related to the technology integration.** Three TPACK-based ID models are part of a crucial set of knowledge that PSTs have to know during a TEP to enhance their competencies regarding a TPACK framework. The aforementioned three models provide various steps and phases along with their functions, but still lack detailed guidance to utilize those steps and phases, which could be considered as a limitation. Further, structural procedures to design and develop a technology-based instruction were not offered to integrate content, pedagogy, and technology simultaneously.

Since those models were constructed in the developed countries, it can be assumed that the first-order barrier might not exist in their contexts. Also, based on the various phases of those models, TEP instructors also experienced difficulties to follow the processes of TPACK-based ID models because of lacking guidance.

The primary goal of TPACK-based ID models was to enhance TPACK competencies of PSTs for carrying out technology integration in the classroom instruction but these models possess limitations in terms of (i) how TEP instructors utilize a TPACK-based ID model (ii) TEP instructors' competencies for creating technology-integrated instructions to train PSTs and (iii) changes in the learning experiences of PSTs after trained under those models. However, the key component of the ID model is to help instructors, which was not investigated during the implementation of TPACK-based ID models among TEP instructors.

Therefore, to address these gaps found in the literature, a new ID model in TEP needs to be considered to assist TEP instructors for creating technology-integrated instructions to carry out technology integration in the classroom instruction. A TPACK-integrated ID model aims to be developed and validated in the study considering the three elements of TPACK and a generic ID model. Thus, to consider all the crucial categories under the same system, a systems thinking approach was adopted in the study.

## Theoretical Background

### A Systems Thinking Approach

A system is a set of elements that function as a whole to achieve a common goal in which an element is a crucial part but not self-sufficient for a system (Betts, 1992). A systems thinking approach is a holistic approach that emphasizes how multiple elements of a system interact with one another instead of isolating the smaller elements (Aronson, 1998). The concept of a systems thinking approach was introduced by Banathy in 1996 when the author strongly believed that the smaller elements of a system could be understood in the context of relationships with each other, rather than in isolation to achieve the goal (Banathy, 1999).

The application of a systems thinking approach in education was part of the educational system to achieve the desired goal. As argued by Despres (2004), an educational system of the twenty-first century is comprised of many obstacles regarding learners, parents, instructors, staff, community members, and government policies. To address those obstacles, a systems thinking approach was adopted by Despres (2004) adopting systematic meta clusters (one of the ways to categorize the elements of a system under few clusters). The findings of the study revealed that these "clusters designate the goals or missions, objectives, and participants in a system" (Despres, 2004, p.5). Further, Nguyen, Bosch, and Maani (2011) in Vietnam also found the identical importance of a systems thinking approach to deal with the obstacles. Therefore, a systems thinking approach could be helpful for enhancing the quality of instruction to improve its productivity.

As explained by Lannon-Kim (1991), a systems thinking approach can be applied in the educational system for two major reasons as (i) for a problem-solving framework to enhance the learners' understanding of content, and (ii) for reconstructing a tool to create an effective educational system. Both reasons were important to re-design current schools to own its unique needs and goals for assisting school instructors and educational designers to prepare learners for the future (King & Frick, 1999). Even more, a study conducted by Chow, Hewitt, and Downs (2013) investigated the impact of various technological resources and external funds for carrying out technology integration in high school classrooms. The findings revealed that categorizing multiple elements under a few clusters assists in identifying major and minor elements for technology integration. Further Rubenstein-Montano, Liebowitz, Buchwalter, McCaw, Newman, and Rebeck (2001) revealed that a systems thinking approach can be used for developing management skills and identifying elements for success and failure.

Thus, the study was also based on a systems thinking approach considering specific elements under a few categories. Those categories and elements are (i) barriers to technology integration (elements: first-order, second-order, and third-order), (ii) technology integration (content, pedagogy, and technology), and (iii) process of ID model. Therefore, this study was based on a systems thinking approach as a theoretical foundation to visualize the interconnection between the three specific types of knowledge, which are the core parts of the study.

## Conceptual Framework of the Study

Figure 2.5 represents the conceptual framework of the study. As mentioned above, the barriers to technology integration and three specific elements were considered to develop the concept of a TPACK-integrated ID model to assist TEP instructors in creating technology-integrated instructions. The figure illustrates that the first-order, second-order, and the third-order barriers were considered as major obstacles to technology integration. Among which, the third-order barriers are related to the TEP instructors' competencies for creating technology-integrated instructions. A foundation of a TPACK-integrated ID model was based on three elements of technology integration as content, pedagogy, and technology as offered by Mishra and Koehler (2006) as the TPACK framework. Further, a generic ADDIE model was adopted to integrate a TPACK framework among all the phases of ADDIE for technology integration.

The study was divided into the four major stages as discussed in the Methodology Chapter (64-65). However, the details concerning Stage 1 are presented here to explain the development of a TPACK-integrated ID model for the pilot study.

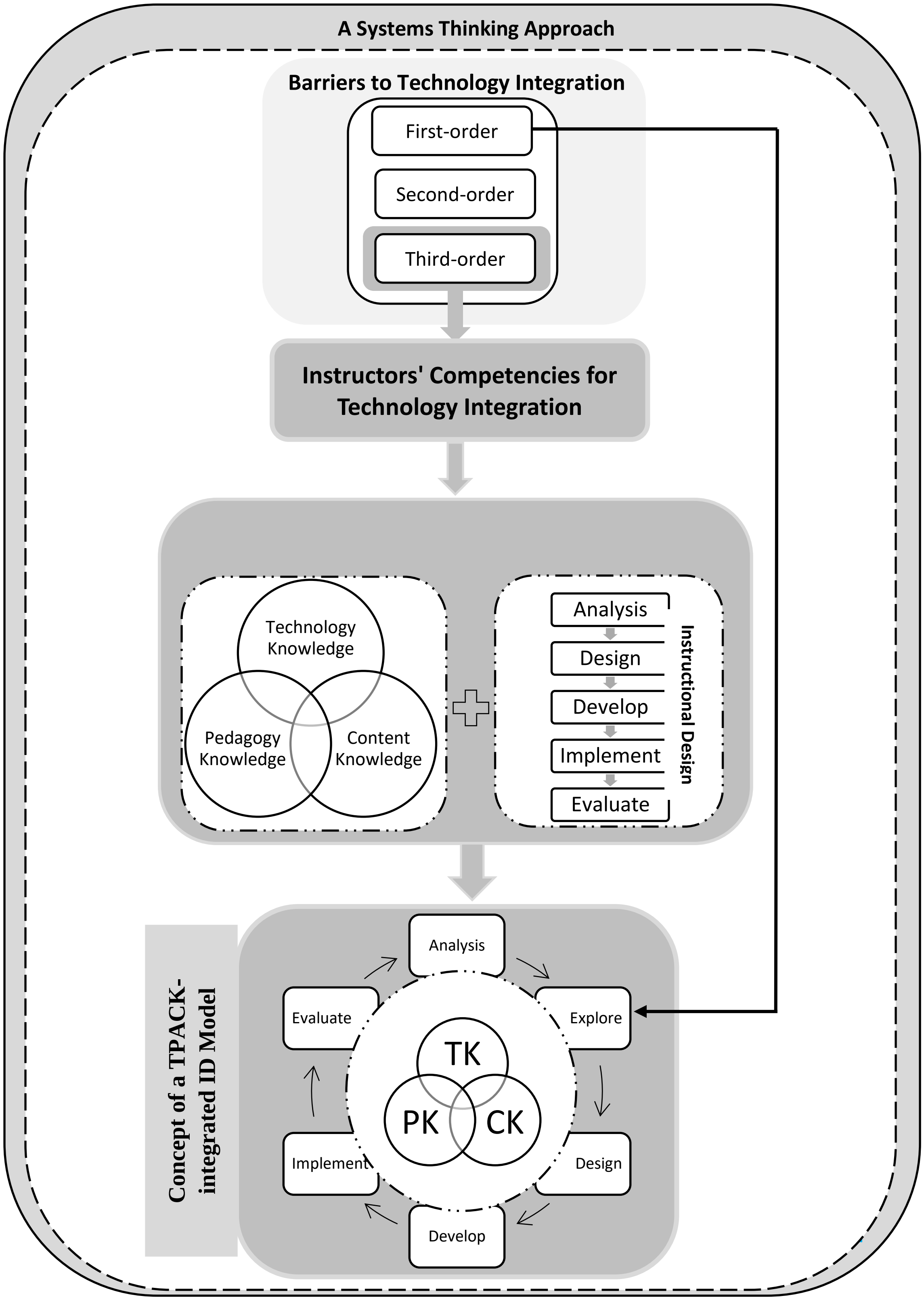



*Figure: 2.5* Conceptual framework of the study

## Development of a TPACK-integrated ID Model for the Pilot study

In Stage 1, a TPACK-integrated ID Model for the pilot study was developed, based on the conceptual framework discussed above. While developing a TPACK-integrated ID Model, five phases of ADDIE were adopted to offer a procedural and classroom-oriented ID model. As highlighted by Miller, Hokanson, Doering, and Brandt (2010), ADDIE provides systematic procedures because it is a recipe for ID models with a formative evaluation at every phase and with a mechanical description for the design process. Further, ADDIE is cost-effective, saves time compared to other ID models, and is consistent for practical training that promotes active learning.

The study was rooted under three specific types of knowledge such as content knowledge, pedagogical knowledge, and technological knowledge that TEP instructor need to have in carrying out technology integration. Thus, a TPACK framework was blended with ADDIE to utilize those three areas of knowledge to various phase of ADDIE. As also highlighted above and in the literature, even if three TPACK-based ID models were developed to enhance the competency of TPACK among PSTs through TEP, it was found to be very difficult to consider content, pedagogy, and technology simultaneously throughout the various phases of such models. Further, Mishra and Koehler (2006) highlighted that TPACK needs to be cohesively practiced as integrated knowledge. Therefore, to address those limitations found in the literature, a TPACK framework and ADDIE were blended for utilizing three types of knowledge regarding content, pedagogy, and technology cohesively throughout the various phases of the ADDIE model.

After blending TPACK and ADDIE, a new phase named *Explore* was added to assist TEP instructor to know the details about technological resources and relevant information for contents and pedagogies. This phase also supports TEP instructor to address the first-order barriers to technology integration. Even more, the reason of adding *Explore* is to provide a platform for the TEP instructor of developing countries for confirming (i) the required course contents that need to be taught during classroom instruction, (ii) technological resources to be utilized after analyzing available resources, and (iii) possible instructional strategies based on the layout of the classroom. Furthermore, even if, the phase named *Analyze* includes *an identifying the learning environment*, the TEP instructor of developing countries could lack their competence about major components that need *to be identified in terms of the learning environment*. This is because studies done by Darnawati et al. (2016) and Karaoglan et al. (2013) revealed that TEP instructor of developing countries lack competency regarding various phases of the ID model itself. Thus, there is a need to add a new phase named *Explore* to address those gap found in the literature for assisting TEP instructors of developing countries.

During the development process of a TPACK-integrated ID model for the pilot study, multiple presentations were made including at the graduate seminar of educational technology (n=6) and graduate seminar of education (n=3). The comments and suggestions received at those seminars were used for refinement of a TPACK-integrated ID model. Also, expert consultations (advisor) was also obtained simultaneously (n=5) which led to the development of a TPACK-integrated ID model for the pilot study presented in Figure 2.6.

**A TPACK-integrated ID Model for the Pilot Study**

Figure 2.6 presents a TPACK-integrated ID model for the pilot study with six phases consisting of *Analyze, Explore, Design, Develop, Implement, and Evaluate*. Under each phase, specific key components and checklists were offered to provide guidelines for TEP instructor. Different phases, key components, and checklists of a TPACK-integrated ID model are discussed below.

**Analyze.** This is the initial phase of a TPACK-integrated ID model with two key components that reference PSTs and educational institutions. For this phase, three checklists were offered including: (i) experiences of PSTs with technological tools and their ownership, (ii) available technological tools and support at educational institutions, and (iii) available educational resources at educational institutions. Studies by Keengwe, Onchwari, and Wachira (2008a) and Mumtaz (2000) found that learners' experiences with technological tools, competencies, and ownership are crucial elements that TEP instructor could consider before practicing technology integration in the classroom instruction. Similarly, technological resources and support are significant especially in the context of developing countries (Bingimlas, 2009). Further, educational resources including reference books, e-books, and open and educational resources are similarly important for TEP instructor to confirm before designing and developing a technology integrated instruction for classroom instruction (Inan & Lowther, 2010).

**Explore.** This is a new phase which was added to the ADDIE to understand the possibilities of using (i) available technological resources and (ii) desired pedagogical strategies for technology integration in the classroom instruction. The necessity of this phase was explained based on the relevant literature and the technology integration models and framework currently in existence.

Vatanartiran and Karadeniz (2015) conducted a large-scale study of 844 instructors to investigate possible obstacles for practicing technology integration in Turkish classrooms. The authors gathered both qualitative and quantitative data using an online survey. The findings of the study revealed that a lack of technological resources in the educational institutions and a low level of learners' readiness were found to be the major hurdles that prevented technology integration. Further, the interview results clarified (i) lack of instructors' information about technological resources even though their educational institutions were in possession of them, (ii) instructors' habits of demanding resources immediately instead of reserving them in advance, and (iii) instructors' negligence to consider learners' readiness to use technology. This study highlighted that instructors need to build habits of confirming available technological resources at their educational institutions and also to know the learners' readiness regarding technology. If positive habits like these are formed, technology integration might be possible even with limited resources.

In the Nepalese context, the United Nations International Children's Education Fund-Nepal (UNICEF-Nepal) (Center for Education Innovations, 2014) reported that a significant quantity of technological resources such as computers, software, and alternative power supply are crucial for technology integration in Nepalese classrooms. However, solely relying on international donors and government funding does not guarantee significant technological resources in Nepalese schools and campuses. Thus, UNICEF-Nepal recommended that instructors need to increase their awareness about those situations and optimize the utilization of available resources for carrying out technology integration during classroom instruction. Further, as argued by Rijal (2013), instructors should not be passive regarding technology integration even if the required technological recourses are not readily available for classroom instruction. To be active in procuring technological resources, instructors could consider various strategies for optimal utilization of available resources and also the pedagogical approaches required to integrate them in the classroom instruction.

Furthermore, as discussed in Chapter 2, the current existing ID models, technology integration models, and framework for technology integration have certain limitations. Even if those models and framework have been practiced to enhance technology integration in the classroom instruction like the ASSURE provides guidance for instructors for developing technology-integrated instruction, they lack a phase in which instructors could verify the required technologies from limited technological resources and also a phase to consider the appropriate pedagogical strategies for delivering a particular content. A similar phase was also missing in the Kemp's model. Further, the SAMR model and TPACK framework lack any guidance in this respect as well.

Thus, based on the evidence discussed above, the necessity of the *Explore* phase was considered for the utilization of limited resources with appropriate pedagogical strategies, mainly in the context of developing countries. A study done by Ramorola (2013) also highlighted that instructors have to investigate the required resources for carrying out technology integration carefully. Thus, the *Explore* phase consists of three key components as possibilities of (i) course contents, (ii) technological tools, and (iii) pedagogical strategies. The main purpose of these three components is to identify the possibilities of utilizing the relevant technological resources as the information of the technological resources was investigated in the *Analyze* phase. Christensen (2015) found that the layout of desks and chairs in the classroom could also be an important factor for carrying out technology integration with the appropriate pedagogical strategies. Recently, Rana (2017) conducted a study in a Nepalese context for carrying out technology integration in the classroom instruction. Based on the findings, Rana (2017) recommended that instructors need to investigate the technological devices and confirm the use of such tools before adopting them for classroom instruction because those devices might not be in working condition, even if Nepalese educational institutions owned them. To accomplish this phase, seven checklists were provided: (i) syllabus, (ii) over-head projector in classroom, (iii) number of computers in lab, (iv) internet, Wi-Fi, and its speed, (v) alternatives during power outages, (vi) layout of desks and chairs in the classroom, and (vii) whiteboards, pens, and erasers in the classroom.

The *Analyze* phase provides information about the technological resources, which helps to confirm all the available possibilities – a step which is particularly important in developing countries. For instance, there might be computers but no electricity and also a lack of chairs and tables inside the classroom. The *Explore* phase consists of the syllabus of the contents that need to be taught; over-head projector in the classroom – whether it is functioning or not; number of computers in the laboratory – to confirm a sufficient number of computers and whether they are working or not; internet/Wi-Fi – to check the speed; alternative power supply – lack of power supply is one of the major problems of developing counties, thus it is important to confirm alternative plans during a shortage of electricity; settings of chairs and tables – some classrooms might have fixed chairs and tables and , so this information allows TEP instructor to adapt pedagogical strategies like group work, individual work etc.; and whiteboards, pens, and erasers in the classroom – lack of these materials are also key characteristics of developing countries and it is important for TEP instructor to confirm these basic requirements too.

**Design**. This is the third phase with three key-components and four steps for the verification of the desired learning objectives, instructions, and evaluation instruments. In this phase, the TEP instructor select the content of the course that they need to teach with appropriate pedagogical strategies and technological tools. Since the study was based on a systems thinking approach and TPACK, the content, pedagogy, and technology need to be considered simultaneously to create the real material for the next phase. Also, evaluation instruments like texts, surveys, and presentations are also designed in this phase. In essence, the output from the *Design* phase will be the blueprint for the *Develop* phase. Thus, the selection of content, technology, pedagogy, and evaluation tools are proposed at this stage.

**Develop.** This is the fourth phase with one key-component and three steps. In this phase, TEP instructor generate the lesson and materials by creating and assembling the content, pedagogy, and technology based on the blueprint from the *Design* phase. This is important because the TEP instructor have to develop the actual lesson and materials they planned in the *Design* phase for carrying out technology integration during classroom instruction.

**Implement.** This is the fifth phase in which TEP instructor deliver the instructions to the PSTs during classroom. It consists of one key component and three steps. In this phase, *learning by design* was included to enhance the capability of PSTs, by allowing them to create a instruction. Hughes (2005) found that these kinds of experiences help PSTs to develop technology-integrated instructions in the future. In this phase, TEP instructor implement the instruction that he/she had prepared in the *Develop* phase. Furthermore, the learning by design concept is also applied to provide practical knowledge to the PSTs which assists them to be a competent instructor who is knowledgeable about technology integration (Koehler & Mishra, 2005).

**Evaluate.** This is the final phase of the model with one key component and three steps. The main purpose of this phase is to understand the quality of instructional products by measuring the learning outcomes of the PSTs including content, pedagogy, and technology. Furthermore, content-knowledge was also measured by tests, which were developed in the previous phase.

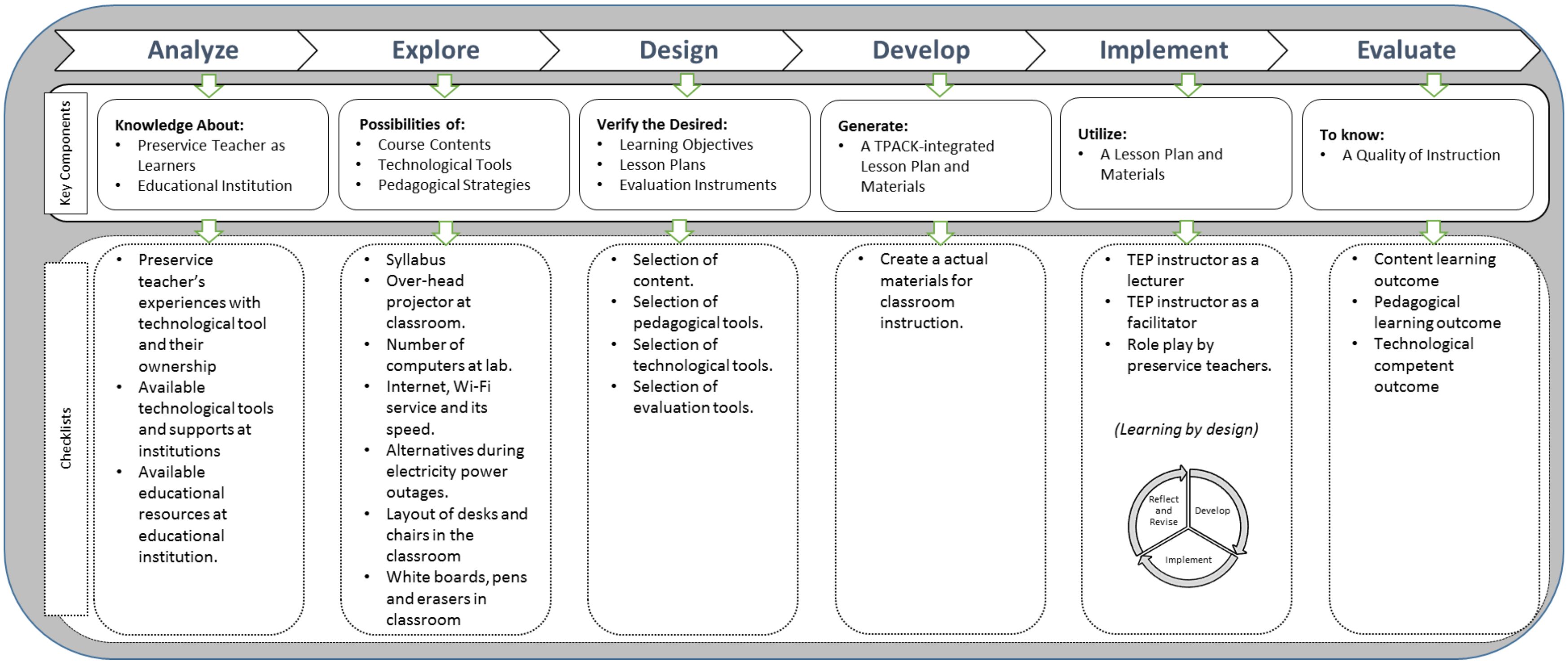



*Figure 2.6.* A TPACK-integrated ID Model for the Pilot Study

# Chapter 3: Methodology

This chapter describes the research methodology employed in the study. Firstly, the research design is explained followed by the context and research procedures. Then details about the main study is elaborated including course of the study, participants, instruments with the methods employed to answer the research questions. Finally, data collection, data analysis and ethical considerations was also presented.

## Research Design

The general design for this study was *Design and Development* research, defined as "the systematic study of design, development, and evaluation processes for the creation of instruction" (Richey & Klein, 2007, p.1). This type of research is also known as developmental or development research and has been considered to be at the heart of the instructional design and technology field to develop a systematic model (Richey, Klein, & Nelson, 2004; Richey & Klein, 2007). As mentioned by Richey and Klein (2007), *Design and Development* research can be employed mainly in two types of development research as: (i) product and tool, and (ii) development and validation of a model.

As proposed by Richey and Klein (2007) *Design and Development* research consists of two major clusters for *development and validation of a model* research as: (i) model development, which includes employing an appropriate theoretical background and relevant literature to create a detailed procedure of a model, and (ii) model validation consisting of internal and external procedures. Thus, the study adopted *Design and Development* research to develop and validate a TPACK-integrated ID model.

In the study, a model development cluster is comprised of: a systems thinking approach as a theoretical background, ADDIE model to provide a generic procedures, three major elements of a technology integration (technology, content, and pedagogy), and relevant literature as part of a model development. Further, a model validation cluster includes: multiple peer reviews from colleagues, faculty of education, and advisor consultation as an internal validation process along with implementation of a model by TEP instructors in TEP and further investigation as an external validation process.

To achieve the goal of the study, mixed methods approach involving both qualitative and quantitative data was employed. The study was carried out in the Nepalese TEP to assist TEP instructors for creating technology-integrated instructions during classroom instruction.

## Context

As reported by the UNESCO, developing countries have already initialized the training for instructors for mastering the skills related to digital technologies and their application in teaching and learning (Anderson, 2010). Similarly, the World Bank has also initiated the implementation of technology for teaching and learning in countries like Russia, Jordan, and Turkey (World Bank, 2017). Even more, the *Master plan of ICT in Education* came into existence in many countries with specific purposes such as: *Enabling future education with ICT* in Thailand, *The global leading country in e-school strategy: Smart school* in Malaysia, and

*Transforming Brunei to a more knowledgeable, thoughtful, multi-skilled, competitive, and smart nation* in Brunei (Park, 2011). Similarly, countries like Nepal, Bangladesh, China, Philippines, and Vietnam also developed the *Master plan for ICT in Education* and have also been benefited from an occasional technology integration training for instructors aided by the international agencies (Park, 2011). Collectively, these national as well as international organizations highlight a need to reduce the digital divide and ensure that even developing countries are able to take advantage of technology integration in the classroom instruction.

In the context of Nepal, the Department of Education (DoE) reported that technologies such as: radio, television, video, telephone, computer, and internet have been used in education, by offering various free educational programs as: radio-assisted instruction, television-assisted instruction, computer-assisted instruction, and internet-assisted instruction (DoE, 2016). Previously, in the 1950's, Radio Nepal started the *Radio Education Program* to provide educational related programs to learners as well as instructors. Further, the *Radio Teacher Training Project* from 1980-1985 was also implemented for qualifying and upgrading educational skills of primary school instructors. In essence, Nepal has been continuously utilizing technologies to empower the instructors and learners since the 1950s.

However, as reported by DoE (2016), even if Nepal has been employing technologies in education since the 1950s, the national policy for technology integration has not enforced until the year 2000. Further, the World Bank (2010) recorded that national level movements about technology integration in Nepal was started in 2000. However, as reported by the National Planning Commission (NPC) an initial five-year plan for technology integration was developed in 2002 under *The Provision of* $10^{th}$ *Plan* (2002-2007), which was followed by *The Three Year*

*Interim Plan* (2007-2010) to enhance technology integration in Nepalese education (NPC, 2007).

Similarly, the Government of Nepal (GoN) reported that *Information Technology Policy* was launched in 2010 to produce technically competent instructors and to expand internet access in schools. Further, the *School Sector Reform Plan* (2009-2015) was introduced for the expansion of technology-assisted teaching and learning in all schools. At the same time, the *Periodic Plan* (2011-2013) was also established for utilizing technology to enhance the access of quality education in rural areas and to integrate technology in all aspects of education. In addition, to offer even more specific plans and policies, the Ministry of Education (MoE), developed an initial *Master Plan of ICT in Education* (2013-2017) collaborating with UNESCO Bangkok in 2013 (MoE, 2013).

The numerous national plans have specific objectives and the *Master Plan of ICT in Education* has envisioned the extensive use of technology integration to provide quality education. It has four specific goals: (i) to expand equitable access to education, (ii) to enhance the quality of education, (iii) to reduce the digital divide, and (iv) to enhance the pedagogical strategies in education. To achieve these goals, four major components in the *Master Plan of ICT in Education* were offered to develop: (i) technological infrastructure, (ii) human resources, (iii) digital learning materials, and (iv) educational management system. As discussed above, various national plans and polices were offered to enhance the technology integration in the Nepalese classroom instruction.

However, Wagle and Jha (2013) argued that even if many plans and polices were developed, technology integration was not found to be practiced in the classroom instruction. GoN (2016) also reported that a significant improvement was not been observed for carrying out technology integration in the classroom instruction even though multiple policies and millions of dollars had already been invested for providing technological resources and training for instructors.

Based on the evidences discussed above, the Nepalese government only prioritized addressing the first-order barriers in technology integration by offering technological resources and training, which are not enough to carrying out technology integration in the classroom instruction (discussed in Chapter 1).

Apart from the Nepalese government, non-governmental and international organizations such as: OLE-Nepal, Microsoft Innovation Center Nepal, and UNESCO Kathmandu are also continuously striving to carry out technology integration in Nepalese classrooms. The key focuses of such organizations are (i) providing technological resources and (ii) training for enhancing instructors' technical competencies to bring technology integration in the classroom instruction. As reported by Karmacharya (2015), based on the *Instructor Training Project* of OLE-Nepal, even if the trained Nepalese instructors were found to be competent in terms of technology and pedagogy because of occasional training, but they were still not found to be skillful in technology integration for the classroom instruction. The reason of this was that the trained instructors were unable to create technology-integrated instructions for carrying out technology integration in the classroom instruction. Further, they also experiences an extraneous cognitive load during the process in technology integration.

Recently, a study done by Bajracharya (2018) observed that even if the rural and urban educational institutions (school and colleges) possessed significant (in urban) and scanty amounts (in rural) of technological resources, instructors were still not utilizing them for technology integration because of their anxiety to use technology and their lack of knowledge to create technology-integrated instructions. Bajracharya (2018) further added that the utilization of those technologies was limited for administrative tasks only. Based on this evidence, the ongoing movements to enhance technology integration in the classroom instruction from government and non-government organizations are not enough for carrying out technology integration in the classroom. Therefore, there is an urgent need to address those obstacles by assisting instructors for creating technology-integrated instructions.

Lim, Cock, Lock, and Brook (2009) observed that TEP prepare PSTs to become the competent instructors for transferring knowledge and skills to the learners. Further, Shukla (2012) argued that for carrying out technology-integrated instructions in the twenty-first century classroom, TEP instructors need to integrate technology while teaching PSTs. Thus, TEP are very crucial to train the PSTs to make them competent instructors in terms of technology integration. This requirement is necessary to achieve the educational goals, especially in the developing countries because of the lack of professional development training for instructors (Al-Zaidiyeen, Mei, & Fook, 2010; Hew & Brush, 2007; Husen, Saha, & Noonan, 1978; Kalyanpur & Kirmani, 2005; Lee & Sparks, 2014).

In Nepalese context, to enhance the quality of education, the GoN has made TEP as a mandatory since 1956 and future instructors are required to attend the program prior to their teaching career (Nepal Campaign for Education Nepal, 2017). A few private universities such as Kathmandu University and Purbanchal University started their TEP since 2002 and 2005, respectively, while massive TEP was carried out by Tribhuvan University since 1959. Tribhuvan University is a national and mega university in Nepal with more than 570 affiliated and 26 constituent campuses that provide TEP such as the Bachelors of Education (B.Ed.) and Master of Education (TU, 2017). In this study the TEP is considered to be B.Ed. degree program.

As reported by the GoN, technology integration has been prioritized to prepare competent PSTs. However, because of lacking: (i) enough resources and (ii) competent TEP instructors in a TEP, technology integration was not practiced to train PSTs (GoN, 2013). Further, a Head of Department of *A* campus explained that TEP instructors were required to teach numerous classes on more than two campuses each day, so they are not willing to invest extra time and effort for creating technology-integrated instructions (D. Khanal, personal communication, December 12, 2016). Even more, as reported by the MoE (2013), even if the GoN has policies to integrate technology in TEP such as: utilization of technological resources to teach PSTs and plans to formulate a new course related with technology integration, specific strategies and plans are still needed for practicing technology integration during classroom instruction. Thus, in view of all that has been mentioned, today's priority has to consider a TEP to train PSTs for carrying out technology integration in the classroom instruction.

This study aims to develop and validate a TPACK-integrated ID model for technology integration in the Nepalese TEP to assist TEP instructors for creating technology-integrated instructions. The study primarily focused on how TEP instructors had utilized a TPACK-integrated ID model through Worked Examples for creating technology-integrated instructions to bring technology integration during classroom instruction. Further, another focus of the study was to improve a TPACK-integrated ID model and Worked Examples based on the empirical findings from the main study.

## Research Procedure

The study was conducted having four major stages to develop and validate a TPACK-integrated ID model for technology integration (Richey & Klein, 2005). Figure 3.1 represents the research procedures employed in the study.

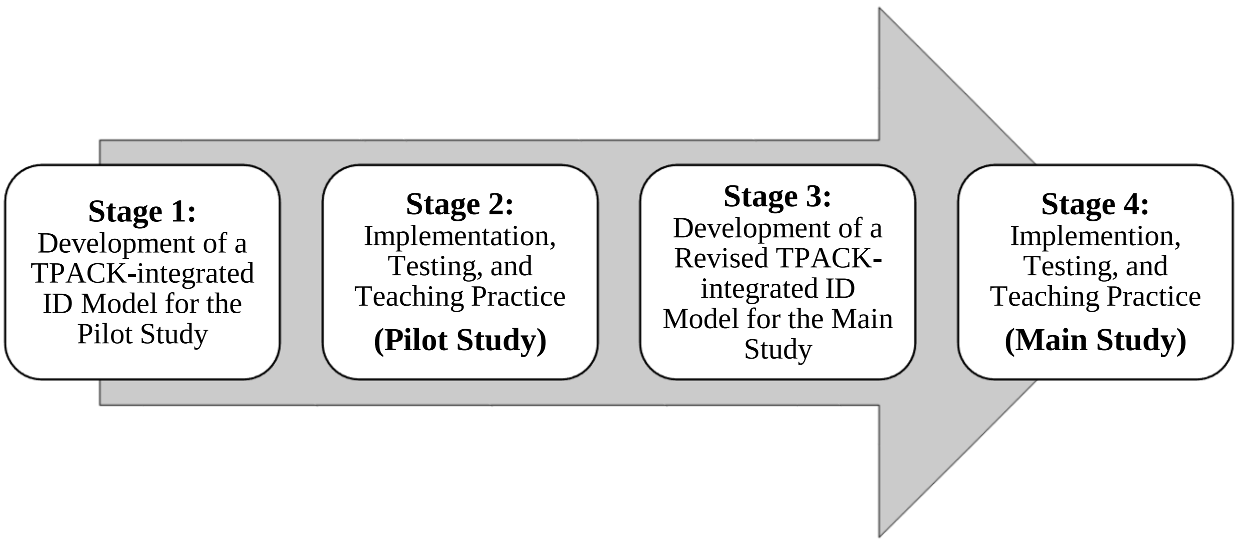



*Figure 3.1.* Four stages to develop and validate a TPACK-integrated ID model
Source: Adapted from Richey and Klein, 2005, p.27

The four stages employed in the study are as follows:

Stage 1: Development of a TPACK-integrated ID Model for the Pilot Study

This was the first stage of the study in which a TPACK-integrated ID model for the pilot study was developed (discussed in Chapter 2).

Stage 2: Implementation, Testing, and Teaching Practice of the Pilot Study

This was the second stage that termed as the pilot study, where a TPACK-integrated ID model was initially implemented in a Nepalese TEP by a TEP instructor for carrying out technology integration in the classroom instruction to educate first-year PSTs of *A* campus. Further, observations were conducted to investigate the TEP instructor's utilization of a TPACK-integrated ID model and the teaching practice of a PSTs was also observed. The pilot study was carried out to revise a TPACK-integrated ID model for the main study based on its findings (discussed in Chapter 4).

Stage 3: Development of a Revised TPACK-integrated ID Model for the Main Study

The third stage was to develop a revised TPACK-integrated ID model for the main study. Based on the findings from the pilot study, peer reviews, advice from faculty of education (International Christian University), and advisor consultations, a revised TPACK-integrated ID model and *Worked Examples* was developed for the main study.

Stage 4: Implementation, Testing, and Teaching Practice of the Main Study

This was the fourth and final stage of the study in which a revised TPACK-integrated model was implemented in a Nepalese TEP. Compared with the pilot study, the main study was done in three different classrooms of a B.Ed. program taught by three different TEP instructors with in *A* and *B* campuses. Further investigations were done to reveal TEP instructors' utilization of a TPACK-integrated ID model through Worked Examples for carrying out technology integration. The teaching practice of the PSTs were also observed. Although this was the final stage of the study, an elaboration of a TPACK-integrated ID model and Worked Examples was also offered based on the findings of the main study for further research.

Since Stage 1 was discussed in Chapter 2 and Stage 2 will be discussed in Chapter 4. Thus explanation of Stage 3 and Stage 4 are discussed here.

### Development of a Revised TPACK-integrated ID Model for the Main Study

The third stage of the study was to develop a revised TPACK-integrated ID model for the main study. Figure 3.4 represents a graphical overview of a revised TPACK-integrated ID model with six phases like a TPACK-integrated ID model in the pilot study. As discussed above, *Worked Examples* were offered in the main study to assist TEP instructors for utilizing the various phases of a model and creating technology-integrated instructions for addressing an extraneous cognitive load of TEP instructors for carrying out technology integration in the classroom instruction. Similarly some modifications were made among key components and steps as discussed below.

In the *Analyze* phase, eight steps were added to analyze the general characteristics and prior knowledge of the PSTs. Secondly, the *Explore* phase consists of three major key components like in a TPACK-integrated ID model for the pilot study, however, the steps were increased from seven to nine for enhancing the possibilities of technology integration by addressing the first-order barriers in technology integration. Similarly, the *Design* phase provides a structure to prepare a instruction through *Worked Examples* for assisting TEP instructors to create technology-integrated instructions, which was not incorporated in the pilot study. Accordingly, the *Develop* phase has two steps to confirm the learning outcomes and assemble content, pedagogy, and technology based on the instruction created in the *Design* phase. Further, based on the findings from the pilot study, role play (learning by design) was graphically deleted from the *Implement* phase because it was very time-consuming and the TEP instructors could make a decision in terms of pedagogical strategies with in the *Design* phase. Thus, role play was considered a pedagogical strategy in a revised TPACK-integrated ID model. In the *Implement* phase, one key component and two steps were included to put the plan into the action. Finally, with the purpose of conducting summative evaluations, learning outcomes and instructions were included as two key components with two steps, which was completed in the *Evaluate* phase. The modifications among key components and phases in a revised TPACK-integrated ID model was done based on the relevant literature, peer review, and expert consultation. Table 3.1 shows key components and steps of a TPACK-integrated ID model under each phase.

Table 3.1

*Key Phases and Key Components of a Revised TPACK-integrated ID Model for the Main Study*

| **Key Phases and Key Components** | *Steps* |
|---|---|
| ***Analyze*** | |
| a. General characteristics of PSTs as learners | i. Gender<br>ii. Age group<br>iii. English language proficiency<br>iv. Ownership of technological tools<br>v. Ownership of technological applications |
| b. Prior knowledge of PSTs as learners | i. Teaching practice experiences<br>ii. Technological and social media experiences<br>iii. Content experiences |
| ***Explore*** | |
| a. Content resources | i. References<br>ii. Electronic database |

| | |
|---|---|
| b. Technology resources | i. Whiteboards, pens<br>ii. Alternatives during power outages<br>iii. Computers<br>iv. Over-head projectors<br>v. Various technological tools and internet/Wi-Fi. |
| c. Human resources | i. Classroom support<br>ii. Technical support |
| ***Design***<br>a. Course learning outcome | i. Define/identify key knowledge<br>ii. Understand key knowledge<br>iii. Apply knowledge to the new situations |
| b. Lesson plan | i. Lesson plan |
| c. Test | i. Written test<br>ii. Presentation<br>iii. Demonstration |
| ***Develop***<br>a. Create a lesson, material, and test | i. List of resources for learning outcomes.<br>ii. Assemble content, pedagogy, and technology to develop technology-integrated instructions |
| ***Implement***<br>a. A lesson | i. Put the plan into action<br>ii. Monitor and support the PSTs' reaction to content, pedagogy, and technology |
| ***Evaluate***<br>a. Learning outcome<br>b. Lesson plan | i. Conduct test<br>ii. Review content, pedagogy, and technology, which were utilized for the creation of materials |

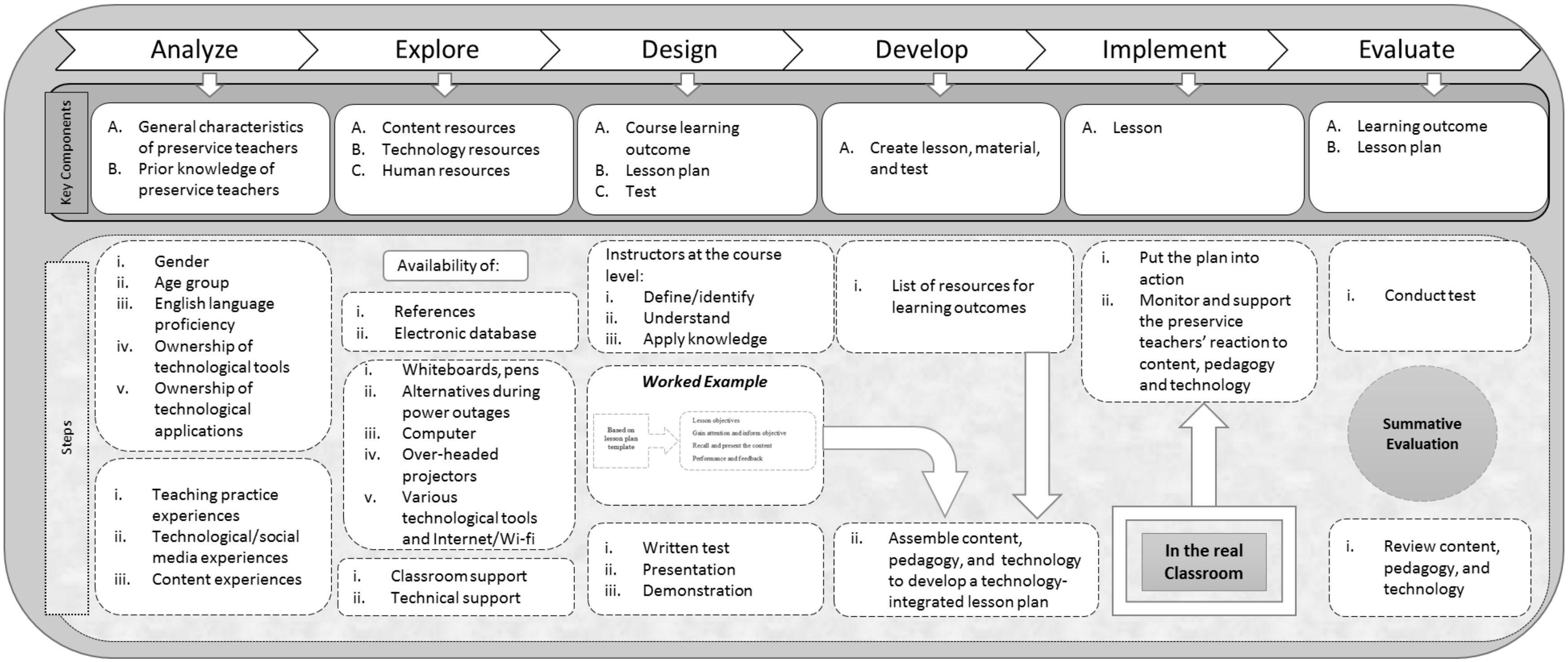



*Figure 3.2.* A Revised TPACK-integrated ID Model for the Main Study

## Implementation, Testing, and Teaching Practice in the Main Study

After developing a revised TPACK-integrated ID model, implementation and testing were conducted as the main part of this study. This section contains the implementation, testing, and teaching practice. The goal of the main study was to validate a revised TPACK-integrated ID model and offer further recommendations to elaborate a TPACK-integrated ID model for future research. In the main study, a revised TPACK-integrated ID model was implemented in three various courses of a B.Ed. program taught by three TEP instructors on two different campuses. The courses were referred to as Case 1, Case 2, and Case 3 in the main study.

### Research Schedule for the Main Study

The research for the main study was scheduled into three phases: before, during, and after the implementation of a revised TPACK-integrated ID model. Table 3.2 elaborates the detailed schedule of the main study among the three different Cases.

Table 3.2
*Schedule for the Main Study*

| | **Case 1** | | |
|---|---|---|---|
| ***Dates*** | ***Phases*** | | ***Activities*** |
| Nov. 2016 | Before intervention | ✧ | Contact a TEP instructor of *A* campus. |
| 8th Dec. 2016 | | ✧ | Pretests: (a) self-efficacy beliefs toward technology integration and attitude toward technology, (b) perceived learning outcomes and paper-based test |
| 14th Dec. 2016 to 11th Jan 2017 | During intervention | ✧ | Meeting with a TEP instructor, reflective journal, classroom observation (observation sheet and PSTs' engagement checklists) |

| | | |
|---|---|---|
| 13th Jan 2017 | After intervention | ✧ Post-tests: (a) self-efficacy toward technology integration, and PSTs' attitude toward technology, (b) perceived learning outcomes and paper-based test |
| 17th to 18th Jan 2017 | Teaching Practice | ✧ PSTs teaching at public school<br>✧ Observations |

| Case 2 and Case 3 | | |
|---|---|---|
| ***Dates*** | ***Phases*** | ***Activities*** |
| *Initial three weeks (Treatment Group)* | | |
| Nov. 2016 | Before intervention | ✧ Contact the TEP instructors of *A* and *B* campus. |
| 7th Dec. 2016 | | ✧ Pretests: (a) self-efficacy beliefs toward technology integration and attitude toward technology, (b) perceived learning outcomes and paper-based test |
| 9th Dec. 2016 to 29th Dec 2016 | During intervention | ✧ Meeting with the TEP instructors; reflective journal; classroom observation (observation sheet and PSTs' engagement checklists) |
| 30th Dec 2016 | After intervention | ✧ Post-tests: (a) self-efficacy toward technology integration, and PSTs' attitude toward technology, (b) perceived learning outcomes and paper-based test |
| 1st Jan to 2nd Jan 2017 | Practicum | ✧ PSTs' teaching at public school<br>✧ Observations |

| | | |
|---|---|---|
| *Final three weeks (Control Group)* | | |
| 8th Jan 2017 | Before beginning of class | ✧ Pretests: (a) self-efficacy beliefs toward technology integration and attitude toward technology, (b) perceived learning outcomes and paper-based test |
| 9th Jan 2017 to 29th Jan 2017 | Typical instruction | ✧ Meeting with TEP instructors; reflective journal; classroom observation (observation sheet and PSTs' engagement checklists) |
| 30th Jan 2017 | After the ending of class | ✧ Post-tests: (a) self-efficacy toward technology integration, and PSTs' attitude toward technology, (b) perceived learning outcomes and paper-based test. |

**Implementation of a Revised TPACK-integrated ID Model for the Main Study**

A revised TPACK-integrated ID model including Worked Examples was provided to the three TEP instructors, which was orally explained to them by a researcher individually. Three TEP instructors were aware of the main purpose of utilizing a revised TPACK-integrated ID model through *Worked Examples* for carrying out technology integration in the classroom instruction. Case 1, Case 2, and Case 3 have been discussed below.

**Case 1.** In the treatment group, the TEP instructor utilized *key procedures and key components of a TPACK-integrated ID model for technology integration* and *designing and developing technology-integrated instructions* through *Worked Examples*. Based on *Worked Examples*, a TEP instructor gathered the required information to accomplish the process and for creating technology-integrated instructions for classroom instruction to teach in the treatment group. However, in the control group, typical instruction was carried out by a TEP instructor.

**Cases 2 and 3.** Like with Case 1, TEP instructors in Case 2 and Case 3 had used a revised TPACK-integrated ID model for technology integration through *Worked Examples* to deliver technology-integrated instruction in the treatment group and as usual instruction. Since Case 2 (n=14) and Case 3 (n=14) consisted of few PSTs compared with Case 1, the same group (n=14) of PSTs in both Case 2 and Case 3, were taught based on the intervention for an initial three weeks, which was termed as the treatment group and the final three weeks were taught based on typical instruction, which was termed as the control group in the main study.

## Course in the Main Study

The main study was conducted in the B.Ed. The duration of the B.Ed. program offered by Tribhuvan University is three years, which follows the annual examination system. The main study was implemented among the three different courses named as: *General English*, *Academic Writing,* and *E-learning* for first, second and third year PSTs under B.Ed. program respectively. Among which, *General English and E-learning* belonged to *A* campus and *Academic Writing* was from *B* campus.

*General English* is a mandatory course for first-year PSTs to develop proficiency in grammar, vocabulary, reading, and enhancing writing skills. Similarly, *Academic Writing* is also an obligatory course for English majors during the second year that aims to equip PSTs with basic writing skills, familiarize them with the fundamentals of the academic writing process, and assist them to utilize published sources for their assignments. Likewise, *E-learning* is a compulsory course for third-year PSTs majoring in ICT that aims to help them to gain sound knowledge about ICT and its applications. The majority of teaching and learning strategies practiced by all the TEP instructors were composed of face-to-face and lecture-based classes. In the following text of the main study, the three different courses have been referred as: Case 1 for *General English,* Case 2 for *Academic Writing,* and Case 3 for *E-learning*.

## Participants in the Main Study

The participants in the main study were TEP instructors and PSTs under a TEP. The demographic information about the TEP instructors was obtained from interviews and that of PSTs was gathered from the pre-survey questionnaires.

### Demographic Data of Teacher Education Program Instructors

As shown in Table 3.3, four TEP instructors had utilized a TPACK-integrated ID model to deliver their regular courses by offering technology-integrated classroom instruction to train PSTs. The main study consisted of three TEP instructors had 12, 11 and nine years of teaching experience. Among these, two TEP instructors belonged to the English department and one from ICT.  Further, two TEP instructors were male and one was female. TEP instructors had also utilized Worked Examples that provided detailed guidance (i) to utilize key phases and key components of a TPACK-integrated ID model and (ii) to create technology-integrated instructions for classroom instruction.

Table 3.3

*Demographic Data of Teacher Education Program Instructors*

| Study | Number | Gender | Teaching Experiences | Highest Degree | Course Taught |
|---|---|---|---|---|---|
| Pilot Study | 1 | Male | 17 | Master (English) | General English |
| Main Study | 1 | Male | 12 | Master (English) | General English |
| | 1 | Female | 11 | Master (English) | Academic Writing |
| | 1 | Male | 9 | Bachelors (Computer Engineering) | E-learning |

**Demographic Data of Preservice Teachers**

Table 3.4 represents the demographic information of the PSTs in the main study. The majority was female (60.7%) and from the Hindu religion (96.4%), which is very representative of the typical Nepalese instructor profile. Most of the PSTs were between the ages 17-19 (67.9%), followed by those in the age range of 20-22 years (30.3%) and those above 23 years (1.8%). In terms of teaching practice experience, most of PSTs had taught for four-weeks (58.9%), followed by those who had six-weeks (7.2%) and those without any teaching experience represents 33.9%. Furthermore, in the context of computer training courses, 64.3% had completed the basic course (MS Office package), followed by those who had a diploma course (1.8%) and 33.9% who did not have any computer-related courses. In terms of ownership of technological resources, all the PSTs from the three different cases had their own smart phones.

Further, PSTs among Case 1, Case 2, and Case 3 were assigned into the treatment and control groups in the main study to investigate the changes on their learning experiences. In Case 1, 28 PSTs were assigned to the treatment (n=14) and control (n=14) groups with matching concepts.

*Gender* and *teaching practices* were considered for matching a pairs because a study done by Markauskaite (2006) revealed that time spent on technological resources by males was significantly high when compared with females. Further, PSTs with having teaching practice experiences were able to make frequent decisions during classroom instruction compared with PSTs with no teaching practice experiences (Nuangchalerm & Prachagool, 2010). Thus, gender and teaching practices were paired for matching in Case 1.

Since Case 2 (n=14) and Case 3 (n=14) consisted of few PSTs compared with Case 1, the same group (n=14) of PSTs in both Case 2 and Case 3 were taught based on an intervention for an initial three weeks, which was termed as the treatment group and final three weeks was taught based on typical instruction, which was termed as the control group in the main study.

Table 3.4
*Demographic Data of Preservice Teachers*

| **Demographic** | | **Numbers** | | | **Total** |
|---|---|---|---|---|---|
| | | **Case 1** (**1st Year**) | **Case 2** (**2nd Year**) | **Case 3** (**3rd Year**) | **Percent (%)** |
| Gender | Male | 13 | 3 | 6 | 39.3 |
| | Female | 15 | 11 | 8 | 60.7 |
| Age | 17-19 | 19 | 8 | 11 | 67.9 |
| | 20-22 | 8 | 6 | 3 | 30.3 |
| | >23 | 1 | 0 | 0 | 1.8 |
| Teaching Practice | 4 weeks | 13 | 11 | 9 | 58.9 |
| | 6 weeks | 3 | 0 | 1 | 7.2 |
| | No | 10 | 3 | 6 | 33.9 |

| | | | | | |
|---|---|---|---|---|---|
| Computer Course | Basic | 17 | 12 | 7 | 64.3 |
| | Diploma | 1 | 0 | 0 | 1.8 |
| | No | 10 | 2 | 7 | 33.9 |
| Ownership of: | Mobile phone | 28 | 14 | 14 | 100 |
| | Desktop PC | 8 | 3 | 6 | 30.4 |
| | Laptop | 2 | 2 | 1 | 8.9 |
| | Internet/Wi-Fi | 18 | 11 | 11 | 71.4 |
| Religion | Hindu | 26 | 14 | 14 | 96.4 |
| | Christian | 2 | 0 | 0 | 3.6 |
| Ethnicity | Brahmin | 14 | 9 | 7 | 53.6 |
| | Chettri | 4 | 0 | 0 | 7.1 |
| | Baishya | 10 | 5 | 7 | 39.3 |

## Instruments for the Main Study

The study utilized seven instruments which were categorized into two parts and followed research questions as represented in Table 3.3 for the data collection described below:

### Observation Sheet, Reflective Journal, and Interview

Three instruments were used to investigate, how the TEP instructors had used a TPACK-integrated ID model through *Worked Examples* (*Worked Examples* was only used in the main study) for carrying out technology-integrated instructions for classroom instruction to train PSTs.

i) **Observation sheets.** The aim of conducting observations was to understand instructional strategies as demonstrated by TEP instructors during classroom instruction. Observations were used to explore how the TEP instructors had utilized a TPACK-integrated ID model through *Worked Examples* for carrying out technology integration in the classroom, as well as to verify and provide a deeper understanding of the meaning of the information gathered from the reflective journal and interview. This sheet was used throughout the study in all the cases including the pilot and main study (see Appendix 4).

ii) **Reflective journals.** This was maintained by the researcher to observe the TEP instructors' strategies of utilizing a TPACK-integrated ID model through *Worked Examples*. Further, it was recorded to know how the TEP instructors followed each of key phases and key components of a TPACK-integrated ID model through *Worked Examples*. As argued by Creswell (2012), a researcher's own reflective journal was used to determine the valuable information that assisted in the understanding of the central phenomenon of the study. The reflective journal was used throughout the study in all the cases both in the pilot and main study.

iii) **Interviews.** Interviews were carried out by the researcher once a week among all the three TEP instructors to investigate their perceptions of a TPACK-integrated ID model and *Worked Examples* while carrying out technology integration in the classroom instruction. Interviews were conducted only in the main study a total of nine times (three interviews for three TEP instructors) (refer to Appendix 5).

**Preservice Teachers' Engagement Checklists, Perceived Learning Outcomes, Paper-based Test, Observations, and Questionnaires**

Five instruments were utilized to investigate the changes in PSTs' learning experiences because of technology-integrated classroom instruction delivered by TEP instructors, which was based on a TPACK-integrated ID model through *Worked Examples*.

iv) **Preservice teachers' engagement checklists.** The checklists were used to observe the PSTs' engagement in the classroom while TEP instructors were delivering their technology-integrated classroom instruction in the treatment group and their typical instruction in the control group. There are various observation checklists available such as: Student Engagement Instrument (Appleton, Christenson, Kim, & Reschly, 2006), School Engagement Scale (Fredricks & McColskey, 2012), Motivated Strategies for Learning Questionnaires (Pintrich & De Groot, 1990), and Student Engagement (Jones, 2009). The checklists developed by the International Center for Leadership in Education was adopted (Jones, 2009) based on the nature of the observations, which was not self-evaluating/or reporting. The checklists was composed of five key components such as: positive body language, consistent focus, verbal participants, student confidence, and fun and excitement. Each of the components consisted of five scales ranging from very high to very low. All the observations, which were structured in nature, were solely observed by the researcher both in the pilot and main study. They were carried out successively, both in the treatment and control groups (refer to Appendix 6).

In the pilot study, the *General English* classroom was observed for three weeks (18 days) which totaled eighteen times each both in the treatment and the control groups. In total, 36 classroom lessons were observed in the pilot study.

Similarly, in the main study, *General English* was observed for 42 times and that of *Academic Writing* and *E-learning* were observed 36 times each. In total, 114 classrooms were observed during the main study.

v) **Perceived learning outcomes.** The perceived learning outcome was measured by survey-questionnaires. The surveys had 33 items with three categories: *Content Knowledge* (18 items), *Pedagogical Knowledge* (8 items), and *Technological Knowledge* (7 items). It was developed by Bajracharya (2015) with a Cronbach's Alpha coefficient of 0.92, which indicated that the instrument was highly reliable. This was used to measure the PSTs' perceived knowledge about content, pedagogy, and technology (refer to Appendix 7). The survey was developed in the context of the Nepalese TEP based on Schmidt, Baran, Thompson, Koehler, Mishra, and Shin (2009).

vi) **Paper-based tests.** The paper-based test was developed by each TEP instructor based on their content to reveal the specific content knowledge. The test was performed both in the pilot and main study for the treatment and control groups (refer to Appendix 8).

vii) **Observations.** The main objective of the observations was to know how the PSTs had taught in schools during teaching practice. The observations were completed by the researcher and school teacher (actual teacher of the school) to investigate a transfer effects of knowledge during teaching practice, which was gained in a TEP. The observation template was developed by the researcher to observe the teaching practice and investigate the overall effects of instructional strategies in the school (refer to Appendix 9).

viii) **Questionnaires.** The questionnaires consisted of two sets of sub-questionnaires including PSTs' self-efficacy beliefs toward technology integration and attitudes toward technology. Those questionnaires were developed by Wang et al. (2004) and Shirvani (2014) that were utilized with proper consent. They consisted of a scale from strongly disagree as 1 and strongly agree as 5 and were was used for both the pilot and main study (refer to Appendix 10)

The summary of instruments used to gather data for the study is shown in Table 3.5.

Table 3.5
*Summary of Instruments*

| **Research questions** | **Instrument** | **Types of data collected** | **Types of data analysis** |
|---|---|---|---|
| *RQ1.* Key phases and key components of a TPACK-integrated ID model | Observation sheet, reflective journal, and interview | Qualitative | Summarizing and drawing conclusions |
| *RQ2.* Implementation of a TPACK-integrated ID model by TEP instructors | | | |
| a) Worked Examples to utilize key phases and key components of a TPACK-integrated ID model by TEP instructors | Observation sheet reflective journal, and interview. | Qualitative | Summarizing and drawing conclusions |

| | | | |
|---|---|---|---|
| b) Worked Examples to design and develop technology-integrated instructions by TEP instructors | Observation sheet reflective journal, and interview. | Qualitative | Summarizing and drawing conclusions |
| *RQ3.* Changes on PSTs' learning experiences based on a TPACK-integrated ID model through Worked Examples | | | |
| a) PSTs' engagement | PSTs' engagement checklists | Qualitative | Summarizing and drawing conclusions |
| b) PSTs' learning outcomes | Perceived learning outcomes and paper-based test | Quantitative | Paired *t*-test and mean score |
| c) PSTs' teaching practices | Observations | Qualitative | Summarizing and drawing conclusions |
| d) PSTs' self-efficacy | Questionnaires | Quantitative | Paired *t*-test and *d* |
| e) PSTs' attitude | Questionnaires | Quantitative | Paired *t*-test and *d* |

**Data Collection**

The study employed qualitative and quantitative data collection techniques consisting of observations, reflective journal, interview, perceived learning outcomes, paper-based test, and questionnaires. The data collection techniques listed below were used to validate and improve a revised TPACK-integrated ID model.

**Observations.** Classroom observations in a TEP were carried out by a researcher as a complete observer (detached from the group) to investigate how TEP instructors utilized a revised

TPACK-integrated ID model through Worked Examples for utilizing *key procedures and key components* and for *creating technology-integrated instructions* in the classroom instruction. Further, observations were done for PSTs' engagement in the classroom during the intervention period both in the treatment and control groups. Similarly, during the PSTs' teaching practice, a researcher and school teacher observed the classroom instruction to know the effects of transfer knowledge and to further investigate the difference between the treatment group and control group in the context of teaching with technology and vice-versa.

**Reflective journals.** These were maintained to observe the TEP instructors' way of using a revised TPACK-integrated ID model through *Worked Examples*.

**Interviews.** These interviews were carried out by a researcher to investigate the perceptions of the TEP instructors' views about a revised TPACK-integrated ID model and *Worked Examples*.

**Perceived learning outcomes and paper-based test.** The pretest and posttest were similar test instruments for perceived learning outcomes and were adapted by Bajracharya (2015). They consisted of 33 items, which were on a scale from one to five from strongly disagree as 1 and strongly agree as 5. The paper-based test was conducted before and after the interventions.

**Questionnaires.** The questionnaires consisted of two sets of sub-questionnaires including the PSTs' self-efficacy beliefs toward technology integration and PSTs' attitude toward technology and were developed by Wang et al. (2004) and Shirvani (2014) respectively.

**Data Analysis**

The study was composed of qualitative and quantitative data, which were analyzed and interpreted using various techniques described below.

**Qualitative data.** In the study, the (i) observations, (ii) interviews, and (iii) reflective journals were employed to gather qualitative data. Observations in a TEP were carried out based on the pre-set categories of themes about technology integration (content, pedagogy, and technology). These data are reported in the study with the support of interviews and reflective journals. The data obtained from interviews were first transcribed. For validity, interview transcripts were compared with the interview recordings, and then checked with the interviewees for further revisions and possible corrections. Further, a manual coding of interview data was done based on the theme of the study for classification under the different categories. Finally, the reflective journals data were also manually coded under the few categories like in the interviews. In summary, qualitative data employed in the study for research question two (a and b), and three (c) were manually coded under pre-set categories of themes and new categories of themes were identified from the data in the observations, interviews, and reflective journals. These methods of analysis were able to provide values that helped to describe and interpret the study population in terms of the demographic profiles of the instructors in the study.

Further, for research question 3 (c), a narrative summary of the PSTs' teaching practice written by the researcher and a school teacher were compiled together and categorized under a few headings and interpreted.

**Quantitative data.** The statistical software Excel version 2013, and SPSS version 20, were utilized to analyze the quantitative data. Descriptive analysis was employed to present the demographic profile of TEP instructors and PSTs in terms of: gender, age, religion, family name, birth place; and teaching experiences; computer training: course name; ownership of laptop and desktop computer; and availability of internet/Wi-Fi and the number and percentage were calculated for each question.

For research question 3 (a), the trends of PSTs' engagement were measured and then concluded. For research question 3 (b, d, and e), the mean scores, a paired *t* test and effect size *d* were calculated to determine the statistical difference among the pretest and posttest between and within the treatment and control groups for reporting the changes of PSTs' learning experiences.

## Ethical Considerations

All the participants including the TEP instructors and PSTs were reported with written acceptance regarding their participation in the research through a signed consent and briefing letter (refer to Appendix 3). The aim of the signed letter was to reassure that participation of the participants in the study was voluntary in nature and participants were not harmed or abused, physically or psychologically, during the study period. Furthermore, participating campuses *A* and *B* were fully informed regarding the purpose of the study and had received permission to conduct the study (refer to Appendix 2). In addition to this, the researcher had passed the research ethics screening of International Christian University to conduct the study in Nepal by using various instruments for data collection (refer to Appendix 1).

# Chapter 4: Pilot Study

This chapter describes detailed about the pilot study. Firstly, the course employed is explained followed by the details about participants, research questions, and research schedules. Then an implementation of a TPACK-integrated ID model is explained. Finally, the findings and discussions of the pilot study were discussed to provide a clearer idea regarding inclusion, exclusion, and modification required to develop a revised TPACK-integrated ID model for the main study. Moreover, it offers an opportunity for checking data presentation, analysis procedures, and methodologies. In addition, it affords a platform for considering the best recommendations to be further investigated in the main study.

## Course in the Pilot Study

The pilot study was conducted in the B.Ed. The duration of the B.Ed. program offered by Tribhuvan University is three years, which follows the annual examination system. The pilot study was implemented in the course named *General English* for first year TEP under B.Ed. program. *General English* is a mandatory course for first-year PSTs to develop proficiency in grammar, vocabulary, reading, and enhancing writing skills.

## Participants in the Pilot Study

The participants in the main study were a TEP instructor and PSTs under a TEP. The demographic information about a TEP instructor was obtained from interviews and that of PSTs was gathered from the pre-survey questionnaires.

### Demographic Data of Teacher Education Program Instructor

As shown in Table 4.1, a TEP instructor had utilized a TPACK-integrated ID model to deliver the *General English* course offering technology-integrated classroom instruction to train PSTs. The pilot study consisted of one full-time male TEP instructor who had 17 years of English teaching experience in a TEP.

Table 4.1
*Demographic Data of Teacher Education Program instructor*

| Number | Gender | Teaching Experiences | Highest Degree | Course Taught |
|---|---|---|---|---|
| 1 | Male | 17 | Master (English) | General English |

### Demographic Data of Preservice Teachers

The pilot study was composed of 28 B.Ed. first-year PSTs from *Academic English* majoring in different subjects such as: Mathematics (50%), English (43%), and Nepali (7%). The female participants dominated the study at 75% (21) and the remaining 25% (7) were male. In terms of ownership of technological resources, all the PSTs had their own smart phones.

## Implementation of a TPACK-integrated ID Model for the Pilot Study

During the intervention period, a TEP instructor was asked to choose few chapters from the *General English* course to teach the same content in the treatment and control groups for three weeks (18 days). On *A* campus, the B.Ed. program was scheduled in the morning from 6:00 am to 10:00 am, where first-year PST have to mandatorily take five classes in a day. The duration of a single class was assigned to be 45 minutes. Since the first-year PSTs have continuous classes

from 6:00 am to 10:00 am, thus the treatment group was scheduled from 5:15 am to 6:00am and the control group was from 9:15 am to 10 am with an official permission from *A* campus.
Before the intervention period, an oral explanation was provided to a TEP instructor concerning a TPACK-integrated ID model including key components and checklists. Details were also provided to perform the required tasks to accomplish six key procedures for designing and developing technology-integrated instructions to deliver the required content in the treatment group. With the explanation and elaboration, even if a TEP instructor was able to follow six phases having those key components and checklists with few obstacles, he experienced hurdles for designing and developing technology-integrated instructions. Thus, a TEP instructor and researcher worked closely to design and develop technology-integrated instructions together. Since the classroom instruction was carried out both in the treatment and control groups during the intervention period, the researcher found that none of the PSTs from the control group had attained the treatment group and vice-versa.

In the pilot study, *an implementation of technology-integrated instructions based on a TPACK-integrated ID model* (the term *intervention* is used throughout the study in the place of *an implementation of technology-integrated instructions based on a TPACK-integrated ID model*) was used to investigate the changes on PSTs' learning experiences. PSTs (n=28) were assigned to the treatment group (n=14) and control group (n=14), using a software named "random randomizer". In the pilot study, the treatment group of PSTs were taught based on an intervention, whereas the control group of PSTs were taught based on *typical instruction* by the same TEP instructor to deliver the same content during the intervention period.

In terms of, designing and developing of technology-integrated instructions for carrying out technology integration in the classroom to teach PSTs, few key components and checklists were also offered under the six phases of a TPACK-integrated ID model. The main purpose of conducting a pilot study was to identify the possible issues that could occur before, during, and after an implementation of a TPACK-integrated ID model, and later to enhance the process of the main study.

**Research Questions for the Pilot Study**

To achieve the purpose of the pilot study, the following research questions were proposed:

1. How do a TEP instructor in a TEP implement a TPACK-integrated ID model for carrying out a technology integration?
    a. How do a TEP instructor utilize a TPACK-integrated ID model to design and develop technology-integrated instructions in the classroom instruction?
    b. What are the benefits and obstacles that TEP instructor experienced during the utilization of a TPACK-integrated ID model?

2. What changes are there on preservice teachers' learning experiences while implementing a technology-integrated lesson based on a TPACK-integrated ID model?
    a. What changes occur in the engagement level of PSTs?
    b. What changes occur in learning outcomes of PSTs?
    c. Is there any knowledge transfer during teaching practice?
    d. What changes occur in self-efficacy beliefs regarding technology integration of PSTs?
    e. What changes occur in attitudes toward technology of PSTs?

3. How do the findings inform to develop a revised TPACK-integrated ID model for the main study?

## Research Schedule for the Pilot Study

The pilot study was scheduled in three steps as shown in Table 4.2, and included the periods before, during, and after the implementation of a TPACK-integrated ID model. Before implementation, a TEP instructor of *A* campus was communicated to receive information of the PSTs. During implementation, pre-tests, classroom observations, and post-tests were conducted for the data collections. After the implementation, a PST from the treatment group was assigned to teaching practice for 5 days to observe his technology-integrated classroom instruction.

Table 4.2
*Schedule for the Pilot Study*

| Dates | Steps | Activities |
|---|---|---|
| June, 2016 | Before intervention | ✧ Contact a TEP instructor of *A* campus and obtain information of PSTs. |
| 7th July, 2016 to | During intervention | ✧ Pretests: (a) self-efficacy beliefs toward technology integration and attitudes toward technology, (b) perceived learning outcomes and paper-based test<br>✧ Classroom Observations |
| 31st July, 2016 | | ✧ Post-tests: (a) self-efficacy toward technology integration, and attitudes toward technology, (b) perceived learning outcomes and paper-based test |

| | | |
|---|---|---|
| 7th August, 2016 to 12th August, 2016 | After intervention | ✧ Trained preservice teachers teaching at public school<br>✧ Classroom Observations |

## Findings from the Pilot Study

In the pilot study, procedure for utilizing a TPACK-integrated ID model by a TEP instructor in a TEP was investigated. The changes on learning experiences of PSTs were also analyzed. A primary goal of the pilot study was to investigate how TEP instructor in a TEP utilize a TPACK-integrated ID model to design and develop technology-integrated instructions. It also examined the benefits and obstacles experienced by a TEP instructor during the process.

**Teacher Education Program instructor utilization of a TPACK-integrated ID model.** Figure 4.3 explains, how a TEP instructor utilized a TPACK-integrated ID model in his course. As prescribed by a TPACK-integrated ID model, a TEP instructor started from the *Analyze* phase where he collected the information about the PSTs and campus based on the checklists. Then, he confirmed the possibilities of using available technological tools and other resources before designing instructions. In the *Explore* phase, a TEP instructor was able to confirm the available resources before designing the instructions. Further, in the *Design* phase, a TEP instructor confirmed the learning objectives and test items. However, he had difficulty in applying the information from the previous two phases to integrate content, pedagogy, and technology for designing and developing technology-integrated instructions to teach PSTs. Therefore, to

*Design* and *Develop* technology-integrated instructions for classroom instruction, the researcher worked closely with a TEP instructor. Even though the duration of a classroom was 45-mintues daily, the designing and developing phase took more than 60 minutes to create materials for a 45-minute class. Having all the materials and written lessons, a TEP instructor implemented a lesson plan and materials during classroom instruction in the *Implement* phase. During this phase, the TEP instructor also offered an opportunities for PSTs for to carry out technology integration instructions for school instruction by attempting a role play. In the role play, PSTs worked among their peers to create materials for classroom teaching. PSTs were also received a feedback from a TEP instructor and other peers. Finally, a test was conducted at the end of the intervention period.

Table 4.3

*Implementation of a TPACK-integrated ID Model for the Pilot Study*

| **Phases** | **Activities carried out by a TEP instructor** |
|---|---|
| Analyze | • Collected information about the PSTs ownership about technologies: smart phones, access to Wi-Fi, mobile applications for English dictionaries and their level of technological skills based on their training.<br>• Collected information about the technological resources possessed by the campus. |
| Explore | • Confirmed with a campus with regards to: accessing computer lab, confirming class with over-head projector, and alternative source of power supply.<br>• Confirmed with an administration about the availability of a classroom with movable desks and chairs.<br>• Confirmed in terms of using specific technological tools (based on what campus and PSTs have) with various pedagogical strategies (like: quizzes, presentation, group work etc.) to |

| | |
|---|---|
| | deliver required content. |
| Design | • Verified the learning objectives.<br>• Designed lesson plans after confirming content, pedagogy, and technology (done in the Explore phase)<br>• Designed test questions for PSTs. |
| Develop | • Generated a 45 minute lesson plan incorporating offline YouTube videos and quizzes to teach content.<br>• Created a test questions for PSTs. |
| Implement | • Implemented a lesson plan in a classroom instruction. |
| Evaluate | • TEP instructor evaluates learning experiences of PSTs in terms of content at the end of an intervention and their own lesson plan. |

**Benefits and obstacles experienced by Teacher Education Program instructor.** During the intervention period, a TEP instructor experienced benefits as well as obstacles during the implementation of a TPACK-integrated ID model.

In terms of benefits, a TEP instructor revealed that the initial phase *Analyze* assisted him to be knowledgeable about PSTs and his own campus about technological and educational resources that could be utilized by him during classroom instruction. Further, he found that the *Explore* phase provided a guide to confirm the possibilities of using technological resources and pedagogical strategies to deliver the required content. He added that previously, the campus had bought some *portable projectors* under government funds, for carrying out technology integration. Despite being aware of the technology, he was not able to use it because a lack of electricity during his classroom instruction. Thus, he realized that the *Explore* phase could help him know other possibilities for utilizing available resources such as changing his classroom and alternative class schedules. Further, a TEP instructor was also benefited from having relevant information about available resources including the physical classroom that helped him to provide for classroom instruction.

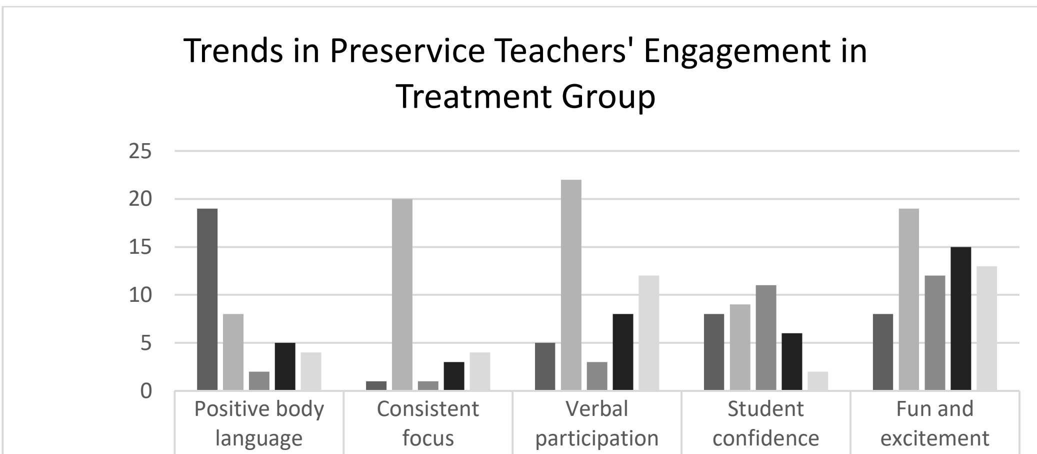
During the intervention, a TEP instructor realized that he was able to have, (i) a classroom with an over-head projector that saved his time to set-up a projector for classroom instruction, (ii) a classroom where he could use internet and alternatives during a power outage, and (iii) a possibility of having technical support from campus to use *google Chromecast* and *offline YouTube videos*. Further, having information about the classrooms such as: classroom with fixed and movable chairs-desks assisted him to offer various pedagogical strategies relevant to the content. Among which, *role play* helped him to engage PSTs in the design and development of lesson plans to deliver instruction during teaching practice. When a TEP instructor delivered a classroom instruction, he realized that having various activities and available technologies with relevant pedagogical strategies in the treatment could reduce his physical stress compared with his typical instruction in the control group where he had to continuously speak for 45 minutes.

Using a TPACK-integrated ID model, a TEP instructor had also experienced some obstacles for carrying out technology integration in the classroom instruction to teach PSTs such as (i) time constrains and (ii) competency to design and develop technology-integrated instructions. To utilize a TPACK-integrated ID model, a TEP instructor was required to collect various information about the PSTs and college through the administration department, asking PSTs about their experiences in technology, certifications, and ownerships, which is a time-consuming process. Further, a TEP instructor experienced that offering a various pedagogical strategies such as role play, class discussions, and presentations was an effective to enhance the engagement level of PST. However the *time framework to complete the annual course* could not be achieved if those pedagogical strategies were been regularly offered.

A TEP instructor was able to accomplish the initial two phases (*Analyze* and *Explore*) without any obstacles. Even if he was competent in pedagogies and technologies, he experienced difficulties to design and develop technology-integrated instructions based on a TPACK-integrated ID model. He added that he was not able to integrate content, pedagogy, and technology based on the key components and checklists provided under the *Design* and *Develop* phase. After working closely with the researcher, a TEP instructor was able to design and develop technology-integrated instructions for implementation in the classroom instruction and then evaluation.

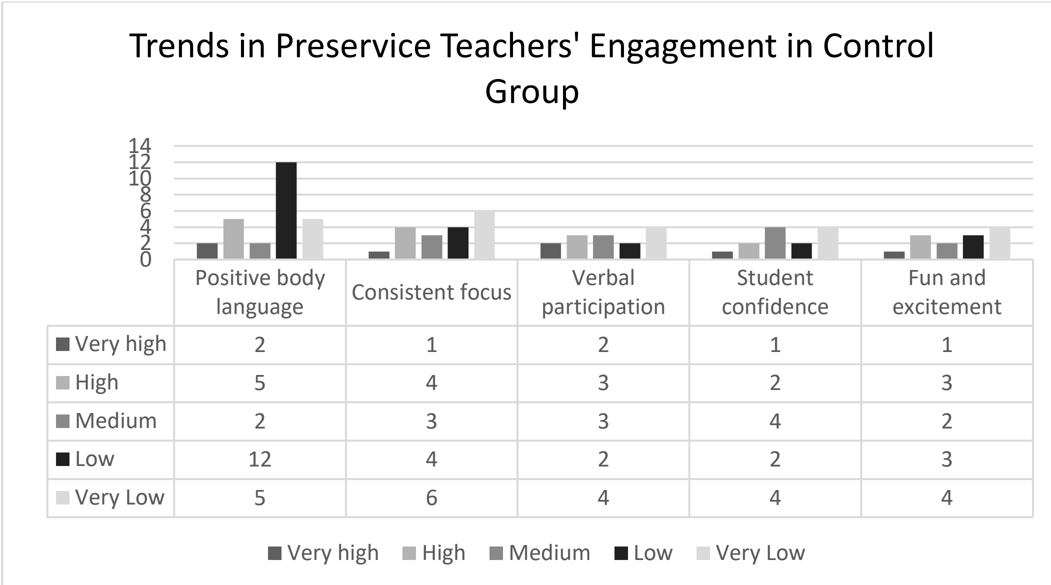
To investigate the changes carried out by the TEP instructor's technology-integrated instruction based on a TPACK-integrated ID model, the PSTs' learning experiences were further analyzed in the context of (i) engagement level, (ii) learning outcomes, (iii) transfer knowledge, (iv) self-efficacy toward technology integration, and (v) attitude toward technology with an implementation of technology-integrated instructions based on a TPACK-integrated ID model

**Preservice teachers' engagement.** Classroom observations were used to analyze the trend of engagement level of PSTs both in the treatment and control groups to the reveal the changes carried out by TEP instructor's technology-integrated instruction. Figure 3.2 and 3.3 shown that the PSTs' engagement was found to be comparatively very high in the treatment group in terms of: positive body language, consistent focus, and verbal participation compared to the control group where PSTs were taught based on the typical instruction. Further, PSTs taught based on a TPACK-integrated ID model were also found to be confident during classroom discussions and their level of fun and excitement was high. This high level of engagement was found because of the instructional strategies used consisting of: group-works, open-questions using PowerPoint, offline YouTube videos, and role play. Thus, the findings revealed that technology-integrated instructions based on a TPACK-integrated ID model do have the potential for the enhancement of engagement level of PSTs during classroom instruction.




| | Positive body language | Consistent focus | Verbal participation | Student confidence | Fun and excitement |
|---|---|---|---|---|---|
| Very high | 19 | 1 | 5 | 8 | 8 |
| High | 8 | 20 | 22 | 9 | 19 |
| Medium | 2 | 1 | 3 | 11 | 12 |
| Low | 5 | 3 | 8 | 6 | 15 |
| Very Low | 4 | 4 | 12 | 2 | 13 |

*Figure 3.2.* Trends in preservice teachers' engagement in treatment group




| | Positive body language | Consistent focus | Verbal participation | Student confidence | Fun and excitement |
|---|---|---|---|---|---|
| Very high | 2 | 1 | 2 | 1 | 1 |
| High | 5 | 4 | 3 | 2 | 3 |
| Medium | 2 | 3 | 3 | 4 | 2 |
| Low | 12 | 4 | 2 | 2 | 3 |
| Very Low | 5 | 6 | 4 | 4 | 4 |

*Figure 3.3.* Trends in preservice teachers' engagement in control group

**Preservice teachers' learning outcomes.** A paired *t* test was conducted to compare the pretests and posttests of treatment and control groups. Table 4.4 shows that there was no significant difference in the pretests between the treatment and control group, $t$ (13) = 0.852, $p$ = 0.410, $d$ = 0.22. However, a paired *t* test analysis shows that there was a significance difference in the posttests between the two groups, $t$ (13) = 2.60, $p$ = 0.22, $d$ = 0.69. The effect size for this analysis was Cohen's $d$ = 0.69 and was found to exceed Cohen's (1988) convention for a medium effect ($d$ = 0.50). These result suggest that the treatment group significantly outperformed the control group. This indicates that technology-integrated instructions based on a TPACK-integrated ID model had indeed significantly improved the learning outcomes, even if the effect size was medium.

Table 4.4

*Paired t Test of Pretest and Posttest of Treatment and Control Groups (N=14)*

| Paired t test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Pretest treatment-pretest control | .0779221 | .3423684 | .0915018 | -.1197555 | .2755997 | .852 | 13 | .410 |
| Pair 2 | Posttest treatment-posttest control | .5502486 | .7905473 | .2112826 | -.0938002 | 1.0066970 | 2.604 | 13 | .022 |

**Preservice teachers' knowledge transfer.** A PST from the treatment group had taught *Compulsory English* for grade six school students in an assigned public school as a part of his teaching practice. Observation by the researcher and a school teacher was carried out for five days and revealed that technologies including a big screen for google Chromecast, Bluetooth speaker, YouTube videos, and smart phones were integrated to deliver the required content by using relevant pedagogical strategies like group work, open quizzes, and discussions for carrying out technology integration in the classroom instruction. Observations revealed that the instructional strategies were learner-centered to engage school students during classroom instruction. Further, the classroom was found to be very interactive because PSTs utilized an offline YouTube video to deliver the content incorporating several oral questions to confirm whether the students were understanding the content or just enjoying the video clip. Based on the observations, it was confirmed that the PSTs who taught based on technology-integrated instructions and offered opportunities to practice technology integration in the TEP could be able to transfer those competencies for carrying out technology integration in the school instruction to produce competent instructors.

**Preservice teachers' self-efficacy beliefs toward technology integration.** A paired *t* test was conducted to compare the pretests and posttests of the treatment and control groups. Table 4.5 shows that there was no significant difference in the pretests between the treatment and control groups, *t* (13) = 1.789, *p* = 0.097, *d* = 0.47. However, a paired *t* test analysis shows that there was a significance difference in the posttests between the two groups, *t* (13) = 2.39, *p* = 0.32, *d* = 0.64. The effect size for this analysis was Cohen's *d* = 0.64, which was found to exceed Cohen's (1988) convention for a medium effect (*d* = 0.50). These results suggest that the treatment group significantly outperformed the control group. It indicates that technology-integrated instructions based on a TPACK-integrated ID model had indeed significantly improved the self-efficacy toward technology integration of PSTs with a medium effect size.

Table 4.5

*Paired t Test of Pretest and Posttest of Treatment and Control Groups (N=14)*

| Paired t test | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Pretest treatment-pretest control | .1928571 | .4032832 | .1077820 | -.0399917 | .4257059 | 1.789 | 13 | .097 |
| Pair 2 | Posttest treatment-posttest control | .6321429 | .9857850 | .2634621 | -.0629676 | 1.2013181 | 2.399 | 13 | .032 |

**Preservice teachers' attitude toward technology.** A paired *t* test was conducted to compare the pretests and posttests of the treatment and control groups. Table 4.6 shows that there was no significant difference in the pretests between the treatment and control groups, *t* (13) = 0.612, *p* = 0.551, *d* = 0.16. Similarly, a paired *t* test analysis shows that there was also no significance difference in the posttests between the two groups, *t* (13) = 1.078, *p* = 0.300, *d* = 0.288. The effect size for this analysis was Cohen's *d* = 0.288, which was found to exceed Cohen's (1988) convention for a small effect ($d$ = 0.20). These results suggest that the treatment group underperformed the control group. It indicates that technology-integrated instructions based on a TPACK-integrated ID model hardly improved the attitudes toward technology with a small effect size.

Table 4.6
*Paired t Test of Pretest and Posttest of Treatment and Control Groups (N=14)*

| | | Paired t test | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Pretest treatment-pretest control | .0788177 | .4815120 | .1286895 | -.1991990 | .3568345 | .612 | 13 | .551 |
| Pair 2 | Posttest treatment-posttest control | .0911330 | .3162154 | .0845121 | -.0914443 | .2737103 | 1.078 | 13 | .300 |

### Lesson Learned for a Revised TPACK-integrated ID Model for the Main Study

The main purpose of a TPACK-integrated ID model was to assist a TEP instructor for creating technology-integrated instructions and addressing extraneous cognitive load of a TEP instructor by addressing barriers in technology integration. In the pilot study, a TEP instructor implemented a TPACK integrated ID model for carrying out technology integration in the classroom instruction to teach PSTs. The pilot study was done to revise a TPACK-integrated ID model and research procedures for the main study. Based on the findings of the pilot study, obstacles were found to be: (i) time constraints and (ii) competency of a TEP instructor to design and develop a technology integrated instruction. Because of this, a detailed guidelines for a TEP instructor to accomplish the six procedures of a TPACK-integrated ID model and to design and develop technology-integrated instructions could be considered during the development of a revised TPACK-integrated ID model for the main study.

Further, in the main study, three TEP instructors from the first-year, second-year, and third-year of a B.Ed. program could be considered to validate a revised TPACK-integrated ID model. The main goal of the study was to assist TEP instructors in creating technology-integrated instructions for carrying out technology integration in the classroom instruction and also for addressing an extraneous cognitive load of the TEP instructors. Thus, to achieve this goal, interviews with all the TEP instructors was conducted to know their perceptions about a TPACK-integrated ID model and how it could address barriers in technology integration.

Accordingly, like in with the pilot study, to improve a revised TPACK-integrated ID model, investigations with regards to the learning experiences of PSTs were considered when assigning PSTs with the treatment and control groups. Thus, to develop a revised TPACK-integrated ID model the following modifications were considered.

1. *Worked Examples* were offered (i) to provide detailed guidance to adhere to the process of a revised TPACK-integrated ID model in the main study and (ii) to design and develop technology-integrated instructions for classroom instruction to teach PSTs (refer to Appendix 11). To offer detailed guidance, checklists were offered based on a revised TPACK-integrated ID model and relevant literature to modify key components and steps (the terms steps is used in the place of checklists hereafter). Further, Gagne's nine events of instruction were used to offer a structure to design and develop technology-integrated instructions. Thus, a revised TPACK-integrated ID model and *Worked Examples* for the main study could be perceived as a package to TEP instructor for carrying out technology integration in the classroom instruction.

2. Three various cases including Case 1, Case 2, and Case 3 with three TEP instructors from two different campuses *A* and *B* were selected to avoid the small sample size and increase the validity of a revised TPACK-integrated ID model. Further, the intervention duration was also increased to four weeks in Case 1 and six weeks in Cases 2 and 3.

3. To triangulate the qualitative data, interviews with TEP instructors were added with the observations and researchers' reflective journals to investigate the TEP instructors' utilization of a revised TPACK-integrated ID model through *Worked Examples* for following key procedures and key components and to design and develop technology-integrated instructions for classroom instruction.

4. PSTs from both the treatment and control groups were assigned to teaching practice to investigate their classroom instruction for carrying out technology integration.

# Chapter 5: Findings

This chapter covers the findings of the main study and the results of the data analysis for the research questions. It first explains key phases and key components of a revised TPACK-integrated ID model and investigates how those key phases and key components were utilized by TEP instructors for designing and developing technology-integrated instructions in a TEP through *Worked Examples*. Further, it explores changes in learning experiences of PSTs with the implementation of technology-integrated instructions delivered by TEP instructors during classroom instruction. In this chapter, a revised TPACK-integrated ID model for the main study was referred to as a TPACK-integrated ID model to avoid confusion during the explanation.

To develop and validate a TPACK-integrated ID model in the context of Nepalese TEP, three major research questions were proposed:

1 What are key phases and components of a TPACK-integrated ID model applying a systems thinking approach?

   a. What are key phases in a TPACK-integrated ID model for technology integration?
   b. What are key components that can be identified in a TPACK-integrated ID model?

2. How do TEP instructors implement a TPACK-integrated ID model for technology integration?

   a. How do TEP instructors utilize key phases and key components of a TPACK-integrated ID model through Worked Examples?

b. How do TEP instructors design and develop technology-integrated instructions for classroom instruction through Worked Examples?

3. What changes do occur in preservice teachers' learning experiences while implementing a technology-integrated lesson based on a TPACK-integrated ID model through Worked Examples?

    a. What changes occur in the engagement levels of PSTs?
    b. What changes occur in learning outcomes of PSTs?
    c. Is there any knowledge transfer during teaching practice?
    d. What changes occur in self-efficacy beliefs regarding technology integration of PSTs?
    e. What changes occur in attitudes toward technology of PSTs?

## Key Phases and Key Components of a TPACK-integrated ID Model

A TPACK-integrated ID model, which was developed to assist the TEP instructors for creating, implementing, evaluating technology-integrated instructions, consists of the following key phases and key components. The explanation of this part section was based on observations, interviews, and reflective journals. In the following text, three TEP instructors from the Case 1, Case 2, and Case 3 were identified as *TEP instructor-1*, *TEP instructor-2,* and *TEP instructor-3* respectively.

### Key Phases

After interviewing with the three TEP instructors, it was revealed that TEP instructor-1 and TEP instructor-2, who were belonged to the English department, practiced learner-centered instructional strategies, whereas TEP instructor-3, from ICT department, practiced a more instructor-centered approach during their typical instruction in the classroom. This was found during observing their classroom instruction both in the treatment and control groups.

In terms of the *Analyze* phase, TEP instructor-1 and TEP instructor-3, who were associated with *A* campus for many years, explained that they knew characteristics of their PSTs and the prior level of their technological ability. It was revealed that the *Analyze* phase was unnecessary for them because they were already familiar with the PSTs. However, based on observations, TEP instructor-1 had used YouTube videos consisting of native speaker from UK for English class, which was found to be very difficult for the first-year PSTs to follow the content. Similarly, without confirming the prior knowledge of the third-year PSTs, TEP instructor-3 had prioritized to use various software and programming by assuming the third-year PSTs were knowledgeable in those technologies. In contrast with TEP instructor-1 and TEP- instructor-3, TEP instructor-2 was also an experienced instructors in a TEP, however she was new to the *B* campus. She explained that

> *"The Analyze phase helped me to know detailed information about my students and their experiences" (Interview, TEP instructor-2).*

Further, the classroom observations revealed that TEP instructor-2 allowed the PSTs to utilize their smartphones during the classroom instruction to use application named *English Dictionary* because she found out that smartphone ownership was 100% among the PSTs and *English dictionary* is a useful tool in *Academic English.*

Interestingly, based on the reflective journals, it was found that TEP instructor-1's knowledge about PSTs was limited to gender and age group and that of TEP instructor-3's was limited to ownership of technological tools and software that were required in the classroom, which would not be considered enough for carrying out technology integration in the classroom instruction.

The *Explore* phase was newly added to investigate the possibility of content, technology, and human resources. Interviews with TEP instructor-1 and TEP instructor-2 found that this phase was very helpful for them because they were made aware of available materials and various technological resources owned by their campuses that could be used as references for their courses. TEP instructor-1 added that

> *"I have been working on this campus for more than 10 years but I am not aware of new technologies owned by the campus" (Interview, TEP instructor-1).*

It revealed that this phase could provide updated information about the resources that could be utilized by TEP instructors. Further, TEP instructor-2 shared that

> *"Even if I am not good in technology, I still prefer to integrate it into my classroom instruction. And this phase provides a platform to create various options and to know support offered by the campus" (Interview, TEP instructor-2).*

Those experiences justify that this phase could provide a detailed information about available resources which could be utilized by TEP instructors. Even more, it offers an opportunities to select technological tools among the available resources. Similarly, TEP instructor-3 also agreed that this phase provides a platform for TEP instructors to learn about the available resources because ICT is changing daily and it is to their advantage to stay informed.

The *Design* phase, which aims to plan desired learning outcomes, instructions, and appropriate testing methods, was initially found to be an extra work for all the TEP instructors. During an interview, TEP instructor-1 revealed that even if, he is a full-time TEP instructor of an *A* campus, he is also doing part-time lectures in other campuses. Because he teaches more than nine classes in a day, he thought that it would be very difficult for him to prepare the required instructions. However, during the end of an intervention period using *Worked Examples*, he had easily completed the required task and further noted the benefit of *Worked Examples* for time management. Further, TEP instructor-2 and TEP instructor-3 added that *Worked Examples* were very helpful for them to create a lesson plan for the classroom and follow the *Design* phase.

Further, TEP instructors were shown how to integrate content, pedagogy, and technology to design technology-integrated instructions for classroom instruction which was also reported in reflective journals as follows:

> *"Easy to follow and reduce my workload to start from scratch (Self Journal TEP instructor-1)"*

> *"Able to utilize smartphone and applications as technological resources (Self Journal TEP instructor-2)"*

> *"Helped me to consider pedagogies during classroom instruction (Self Journal TEP instructor-3)"*

The *Develop* phase aims to create actual materials as planned in the *Design* phase. Initially, TEP instructor-1 and TEP instructor-2 were confused about this phase because they explained that they could develop a lesson plan and the required materials based on the *Worked Examples* provided in the *Design* phase. However, TEP instructor-3, who is familiar with the ADDIE model in software development, understood about having the *Design* and *Develop* phases. Since Worked Examples to design and develop technology-integrated instructions were provided, TEP instructor-3 was also agreed that relevant materials could be also created simultaneously. Based on the TEP instructors' point of view, the *Design* and *Develop* phase could be integrated into the same phase.

Since *Worked Examples* consist of four major steps such as (i) gain attention and inform objective, (ii) recall and present the content, (iii) performance and feedback, and (iv) enhance retention transfer to new situations for designing and developing technology-integrated instructions. Even if, TEP instructors found that it was very helpful for considering content, pedagogy, and technology simultaneously under each steps to deliver technology-integrated instructions some found that they needed to focus more on content. For example, an interview with TEP instructor-3 added that

> *"Yes, it helps me a lot to consider content, pedagogy, and technology simultaneously, however, I might not able to have "performance and feedback" in everyday classes because I have to teach many lecture-based lessons to*

*PSTs before doing any activities during classroom instruction" (Interview, TEP instructor-3).*

In the *Implement* phase, all the plans were put into practice to deliver classroom instruction. Based on the classroom observations both in the treatment group and control groups, it was revealed that the three TEP-instructors were able to deliver technology-integrated instructions based on a TPACK-integrated ID model through *Worked Examples* in the treatment group and their typical instruction in the control group. Based on an interviews, all the TEP instructors shared that they had obstacles in terms of monitoring the reactions of all the PSTs toward content, pedagogy, and technology because they had to deliver the required lesson including activities within the short period of time. Further class observations revealed that the TEP instructors were not able to monitor reactions of PSTs because of the time constraint.

The *Evaluate* phase aims to assess the quality of a lesson plan and the learning outcomes of PSTs. All the TEP instructors said that this phase helped them in designing and developing technology-integrated instructions in future and also provided opportunities for the PSTs to revise the lessons for the tests.

**Key Components**

As presented above few key components and several steps were provided in the main study, which were utilized by the TEP instructors through *Worked Examples* for carrying out technology-integrated instructions for classroom instruction.

During an interview, TEP instructor-1 and TEP instructor-3 argued that they could skip key components and steps under the *Analyze* phase. However, based on classroom observations it was revealed that TEP instructor-1 and TEP instructor-3 were able to learn more information about their PSTs than they originally would have after utilizing key components and steps. Further, toward the end of the intervention, TEP instructor-1 and TEP instructor-3 both agreed that having information about PSTs' experiences in terms of English proficiency, teaching practice, and content experiences assisted them to select appropriate videos and technical applications during their classroom instruction. Further, TEP instructor-1 added that first-year PSTs were usually enrolled from various background and their major is different (In Nepal, PSTs have to select their major during first-year of TEP). Thus, he revealed that understanding about the content experiences of PSTs allows him to select required materials, which could be understood by all the PSTs during classroom instruction. Since TEP instructor-2 was found to be utilizing key components through *Worked Examples*, she explained that as an experienced but new TEP instructor (in *B* campus) like her, who did not know much about PSTs, learning about those components help to collect required information about PSTs for the creation of relevant lesson plan and materials for classroom instruction.

As explained above, the *Explore* phase provides opportunities to acquire the possibilities of available resources in terms of content, technology, and support available at campus. TEP instructor-1 and TEP instructor-2 found the key components under this phase helped them to select the most relevant resources in terms of content and pedagogy. Further, class observations revealed that TEP instructor-2, having low technical competency utilize technical support from *B* campus on an advance, which further saves a required time to set-up projector in the classroom.

Based on the interviews, all the TEP instructors found that *Worked Examples*, which were offered to design and develop technology-integrated instructions were easy to apply by assembling content, technology, and pedagogy. However, they found that the components under the *Design* and *Develop* phases could be accomplished together. Further, TEP instructor-1 and TEP instructor-3 added that providing details about *course learning outcomes* in the *Design* phase was time-consuming for them because that were written in the textbook of the course curriculum prescribed by Tribhuvan University. Based on the classroom observations, TEP instructor-2 prepared the specific course learning outcomes with key elements compared with TEP instructor-1 and TEP instructor-3 who did not have general course learning outcomes. Further, TEP instructor-3 added that a technical TEP instructor like him, who was never trained to design a lesson plan, creating such detailed plans were very profitable to use in practice, even if it was a time-consuming process.

During the *Implement* phase, TEP instructors explained in the interviews that they had developed a lesson for every day through *Worked Examples* during an initial week of the interventions. However, later on, they developed lesson plans for two to three days on one sitting because of time constraints. During classroom instructions, it was observed that TEP instructors had used various technologies and instructional strategies such as Offline YouTube videos by TEP instructor-1 because there is was no internet in his class. Because of this, he also used presentations and group discussions. Similarly, TEP instructor-2 utilized smartphone activities and peer work. However, classroom interaction in Case 3, by TEP instructor-3 was found to be less interactive if compared with TEP instructor-1 and TEP instructor-2. Interview data with TEP instructor-3 revealed that he had to deliver lecture-based classroom instruction because PSTs have to know specific knowledge about the content before participants in any classroom discussions. Further, it was observed that third-year PSTs were busy in preparing their final annual examination and preparing the job-hunting process.

During the *Evaluate* phase, the TEP instructors evaluate the learning experiences of PSTs based on the test which was written in nature as prescribed by Tribhuvan University. However, the activities such as *presentation* and *demonstration* were practiced by all except by TEP instructor-3. Further, all three TEP instructors found that evaluating their own lessons helped them to further improve, even if it was time-consuming for them compared with their typical classroom instruction.

## Implementation of a TPACK-integrated ID Model

In the main study, three TEP instructors implemented a TPACK-integrated ID model for carrying out technology integration during classroom instruction. TEP instructors were offered *Worked Examples* to utilize key phases and key components of a TPACK-integrated ID model and to design and develop technology-integrated instructions for classroom instruction.

### Utilization of Key Phases and Key Components through Worked Examples

The procedures carried out by the three TEP instructors to utilize key phases and key components through *Worked Examples* are discussed below:

At the phase of *Analyze*, having two components and eight steps were carried out by TEP instructors to learn about the PSTs. To collect the required information, TEP instructor-1 and TEP instructor-2 prepared a comment sheet, which was based on *Worked Examples*. Similarly, TEP instructor-3 utilized a course blog to gather additional information. Based on classroom observations, TEP instructors were able to know beyond the general information about the PSTs, even though TEP instructor-1 and TEP-instructor-3 were said that they were already familiar with the PSTs. A second interview with TEP instructor-2 revealed that the *Analyze* phase enhanced her knowledge about the PSTs.

At the phase of *Explore*, an interview with TEP instructor-2 revealed that she was able to find out about the various resources possessed by *B* campus, which could be used by TEP instructors during classroom instruction. Further, she added that an experienced but a new TEP instructor like her would benefit from this phase. Based on the classroom observations, she used smartphones in the classroom because all the PSTs possessed one. Smartphone usage was also helpful because there was no electricity twice a week (Monday and Thursday) because of scheduled power outages. From interview data, compared with TEP instructor-3, TEP instructor-1 was unaware about the opportunities of using resources on his campus where he had been teaching for last 10 years. To collect the required information, all the TEP instructors visited the library, the ICT department, and the administrative department of their respective campuses. It was found that the TEP instructors were able to collect the required information very quickly because of *Worked Examples*.

At the phase of *Design*, based on the collected information from the *Analyze* and *Explore* phases, the TEP instructors were required to plan a desired lesson plan and test items based on the course learning outcomes. Interviews with the TEP instructors revealed that they were experienced in a TEP, however, but if they were required to design a lesson plan including the creation of lesson materials for classroom instruction, they informed that they were not preparing written materials because of a lack of time. However, TEP instructor-3, who was from a technical background, further elaborated that he was never trained to develop those types of lesson plans except for a few occasional short-term trainings. Further interviews with the TEP instructors concerning Worked Examples to design technology-integrated instructions revealed that they provided detailed guidance including *topic of lesson*, *PSTs need to learn*, and *PSTs need to do at the end of class*, which provide insightful clarification about what to teach in the classroom with detailed plans. Further, TEP instructor-1 and TEP instructor-2 added that it also helped to manage time in terms of activities and to be assured about learning experiences of PSTs. Similarly, TEP instructor-3 also added that it helped him to consider various pedagogical strategies for a specific purpose, such as creating a quiz to know about the PSTs' level of content knowledge. However, based on observations, role play was occasionally used by all the TEP instructors, because of the time constraint experienced, which was also shared by the TEP instructors during interviews.

At the phase of *Develop*, after choosing the required content, pedagogy, and technology to achieve the learning objectives in the *Design* phase, this phase consisted of creating and organizing the actual learning material carried out by the TEP instructors during classroom instruction. Based on interviews, TEP instructors created a learning material with detailed guidance for classroom instruction. TEP instructor-1 and TEP instructor-2 added that technical support from their campus helped them to address technical hurdles experienced while developing technology-integrated materials such as: having English YouTube videos with Nepalese texts, connecting TEP instructors' mobile phone in *google Chromecast* and downloading *offline YouTube videos* in smartphones. Further, it was observed that technical supporter assisted them to use the projector during the classroom instruction by TEP instructor-2. However, TEP instructor-3 revealed that integrating periodic role play was found to be difficult in his course because there are various technical concepts, which needed to be delivered through lecture-based instruction. Thus, even if, TEP intructor-3 preferred to have a role play during classroom instruction, he created a lesson plan and materials with scheduled role play three different times during the three-week period of intervention.

At the phase of *Implement*, classroom observations revealed that TEP instructor-1 and TEP instructor-2 had utilized various technological resources (*PowerPoint*, *YouTube videos*, *Facebook*, *Smart Phone*, *Google Chromecast, and Wi-Fi/Internet*) and pedagogical strategies (*Open questions, Group work, Roleplay, Quizzes, Demonstrations, and Class presentations*) to deliver the required content to their PSTs. Further, during the interviews with TEP instructor-1 and TEP instructor-2, it was found that even if, they created the materials, TEP instructor-2 was still not confident to deliver a technology-integrated lesson in the classroom because of a fear of technology. However, TEP instructor-1 realized that even if a lesson plan provides a guidance on time management, but he was not able to deliver the intended lesson within 45 minutes. He learned that he needed more time because the PSTs were first-year students with various levels of knowledge in terms of content, which took more time for multiple and detailed explanations. Further, TEP instructor-1 and TEP instructor-2 were delivered their classroom instruction in various types of classrooms such as classrooms with movable chairs and desks, a computer lab, an assigned classroom with fixed chairs and desks, and classrooms without chairs and desks for various pedagogical strategies. However, based on the classroom observations, even if, TEP instructor-3 had used various technologies to deliver the required content, he was not able to utilize pedagogical strategies as planned during the *Design* and *Develop* phases. Classroom instruction was found to be lecture-based and the TEP instructor-3 had engaged PSTs with open questions and group presentations. An interview with TEP instructor-3 clarified that he chose this method because the PSTs have to know many technical and programming knowledge before doing any class discussions and group work activities.

At the phase of *Evaluate*, interviews with all the TEP instructors revealed that they conducted tests among their PSTs to measure their knowledge about specific content. All the tests were designed and developed in the *Design* and *Develop* phases based on the national curriculum. Further, the TEP instructors performed a self-evaluation about their own lesson plan and materials. However, based on an interview with TEP instructor-3, it was found that there were no criteria offered by a TPACK-integrated ID model for self-evaluation of a lesson plan and materials.

**Designing and Developing a Technology-integrated Lesson Plan through Worked Examples**

As discussed above, *Worked Examples* were provided for TEP instructors to utilize key phases and key components of a TPACK-integrated ID model. Similarly, to design and develop technology-integrated instructions, *Worked Examples* were offered to the three TEP instructors. Explanation under technology integration was carried out based on the classroom observations, interviews, and reflective journals as described below:

**Technology integration.** Classroom observations revealed that the TEP instructors utilized *Worked Examples* for indexing specific information a *topic of a lesson*, *PSTs need to learn*, and *PSTs need to understand at an end of the classroom instruction*. It was also confirmed by the reflective journals that all the TEP instructors had developed their lesson plans and detailed notes about content, pedagogy, and technology based on the information from the *Analyze*, and

*Explore* phases. Since detailed guidance was provided in the *Worked Examples*, TEP instructors had utilized the various pedagogies and technologies presented to gain attention and inform objectives, to recall and present the content, to perform and gather feedback, and to enhance retention transfer.

Interviews with the TEP instructors clarified that based on the detailed information about content, pedagogy, and technology in the *Analyze* and *Explore* phases, they had designed and developed technology-integrated instructions. TEP instructor-1 mentioned that

> *"Since detailed guidance with a key purpose was provided, thus I had followed those guides to develop technology-integrated instructions. Further, based on that plan, I created a required material for classroom instruction" (Interview, TEP instructor-1).*

The above statement of TEP instructor-1 clarifies that *Worked Examples* provided the detailed guidance to integrate content, pedagogy, and technology for technology-integrated instructions. Similarly, TEP instructor-2 further added that

> *"I just followed the Worked Examples to design and develop technology-integrated instructions, however, sometimes I was unable to follow all the detailed guidance because I found it was too much" (Interview, TEP instructor-2).*

An interview with TEP instructor-2 revealed that even if *Worked Examples* were self-guided instructions the TEP instructors might not cover all the detailed guidance. However, TEP instructor-3 revealed that

> *"For a technical TEP instructor like me, this type of Worked Examples is very helpful that provide detailed guidance (Interview, TEP instructor-3).*

Based on the above evidences, it was clarified that *Worked Examples* provided a detailed guidance which helped the TEP instructors to design and develop technology-integrated instructions.

Further, based on the interviews with three TEP instructors, even if, they had practiced technology-integrated instructions in the past, they still lacked the competencies needed to create a technology-integrated lesson and materials for classroom instruction. For example, TEP instructor-1 mentioned that

> *"Previously, I had used videos during classroom instruction to enhance the understanding level of PST in terms of the contents, but I was not sure whether they were perceiving knowledge or not. However, Worked Examples to create a technology-integrated lesson and materials helps me to consider content, pedagogy, and technology simultaneously, which enhance the engagement level of PSTs in the classroom instructions, further, it confirms their perceived knowledge too" (Interview, TEP instructor-1).*

The above statement by TEP instructor-1 justifies that, the pedagogical strategies were not practiced previously to deliver a technology-integrated classroom instruction. The *Worked Examples* offered to the TEP instructor-1, helped him to consider the content, pedagogy, and technology for carrying out technology integration. Further, it also assisted the PSTs to internalize the delivered instructions. Similarly, TEP instructor-2 added that

> *"Even if, I am aware of the potential of technology integration, however, I was afraid of using technologies during classroom instruction because of my low technical ability. In the past, I always have to request my colleagues for assisting in delivering a technology-integrated lesson. However, I became surprised by knowing smartphones could enhance vocabulary of PSTs and Facebook for sharing the opinions. I must have to say that it allows me a freedom to select my desired technologies"* (Interview, TEP instructor-2).

The TEP instructors' reflections show that *Worked Examples* provide the freedom for TEP instructors to select the appropriate technologies. Furthermore, TEP instructor-3 revealed that

> *"I used to teach technical subjects that modify often in terms of applications, software versions, and hardware tools. Worked Examples provide a roadmap to consider various instructional strategies to deliver required contents. However, even various pedagogical strategies could be considered but I was unable to utilize pedagogies in my classroom"* (Interview, TEP instructor-3).

Reflection by TEP instructor-3 revealed that *Worked Examples* could be much more profitable in a technical subject compared with non-technical subjects. Based on the classroom observations, it could be further elaborate that classroom instruction based on the Worked Examples provide technology-integrated instructions in terms of content, pedagogy, and technology compared with the classroom instruction that was based on the typical instruction used previously.

## Changes in Preservice Teachers' Learning Experiences

The study further investigates the changes in the learning experiences of PSTs, where TEP instructors utilized a TPACK-integrated ID model through *Worked Examples* for carrying out technology integration in the classroom instruction.

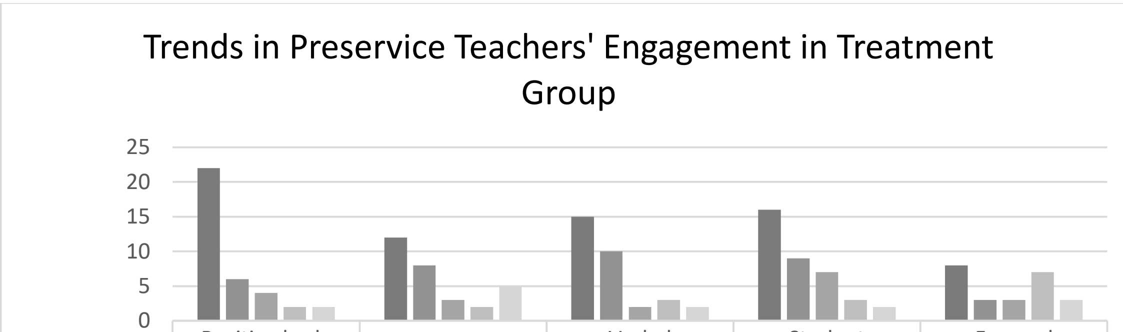
The changes were investigated in terms of PSTs': engagement level, learning outcomes, knowledge transformation during teaching practice, self-efficacy toward technology integration, and attitude toward technology, for further improvement of a TPACK-integrated ID model and *Worked Examples*. The study used an alpha, α level of .05 for all statistical tests.

### Preservice Teachers' Engagement

As in the pilot study, the investigation was carried out to understand the trends of engagement level of PSTs in the classroom.

Figures 5.1 and 5.2 represent the trends in engagement level of PSTs both in the treatment and control groups of Case 1. Based on the daily classroom observations, engagement level was found to be comparatively very high in the treatment group in terms of positive body language;

consistent focus; verbal participation; confidence; and fun and excitement. These findings revealed that technology-integrated instructions taught by the TEP instructors were found to be effective to enhance engagement level of PSTs. It implies that the PSTs were active in the classroom and interactive in the classroom discussion.




| | Positive body language | Consistent focus | Verbal participation | Student confidence | Fun and excitement |
|---|---|---|---|---|---|
| Very high | 22 | 12 | 15 | 16 | 8 |
| High | 6 | 8 | 10 | 9 | 3 |
| Medium | 4 | 3 | 2 | 7 | 3 |
| Low | 2 | 2 | 3 | 3 | 7 |
| Very Low | 2 | 5 | 2 | 2 | 3 |

Very high  High  Medium  Low  Very Low

*Figure 5.1.* Trends in preservice teachers’ engagement in treatment group

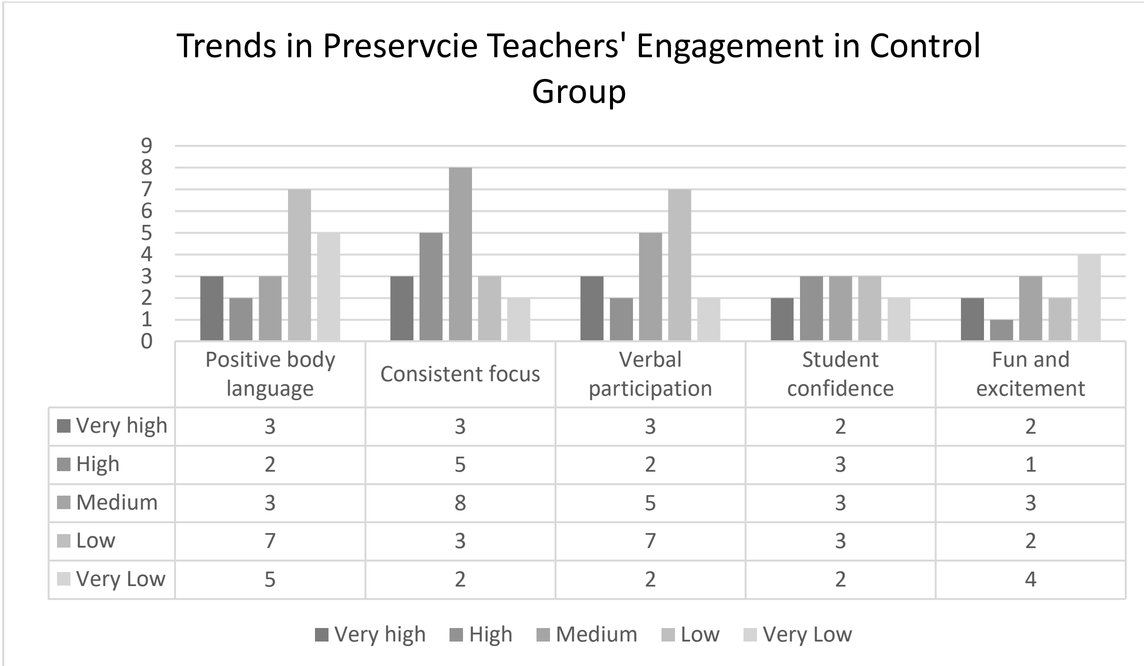



*Figure 5.2.* Trends in preservice teachers' engagement in control group

Figures 5.3 and 5.4 explore the trends in engagement level of PSTs in Case 2. Similar to Case 1, the level of engagement was very high in the treatment group compared with the control group.

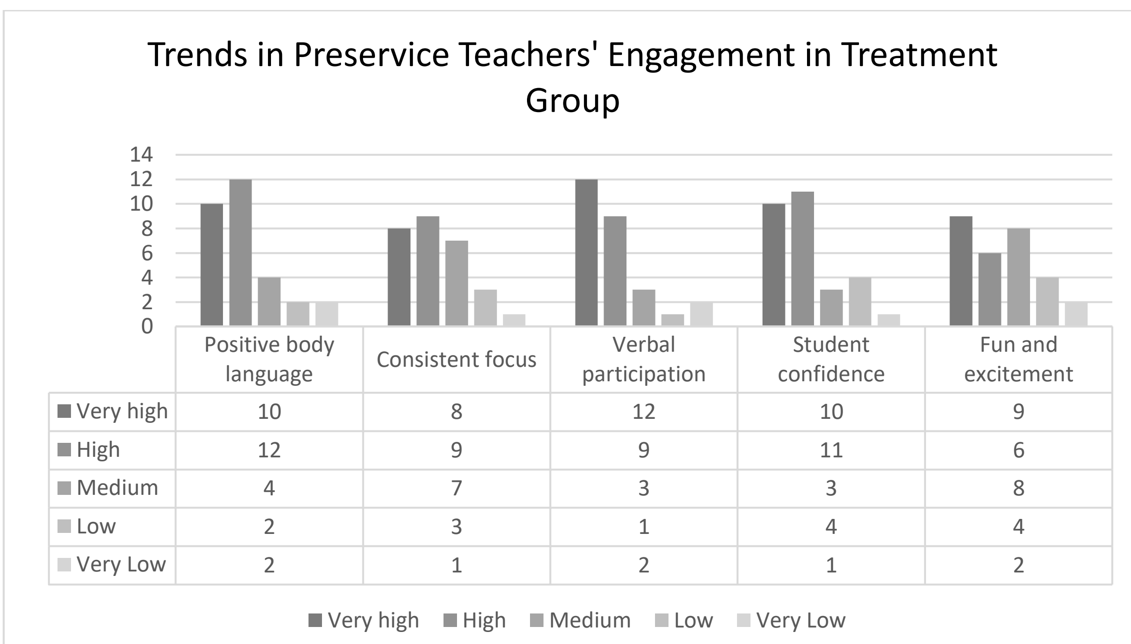



*Figure 5.3.* Trends in preservice teachers' engagement in treatment group

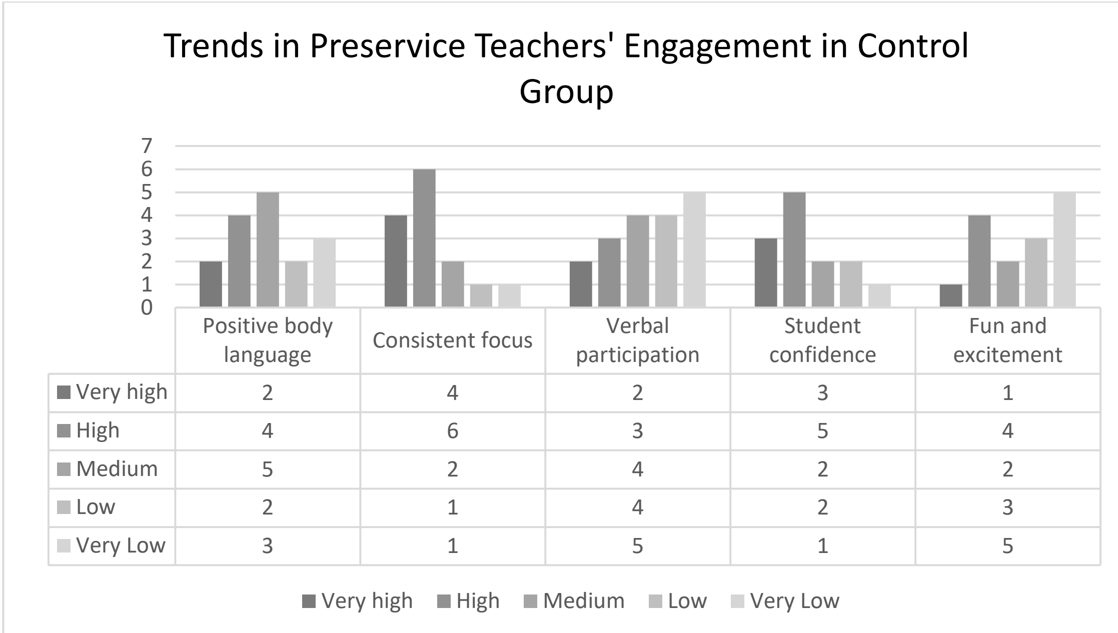



*Figure 5.4.* Trends in preservice teachers' engagement in control group

In contrast with Cases 1 and 2, Figures 5.5 and 5.6 show that engagement level of PSTs was also found to be high in the control group in Case 3. Further, both the treatment and control groups was found to be high.

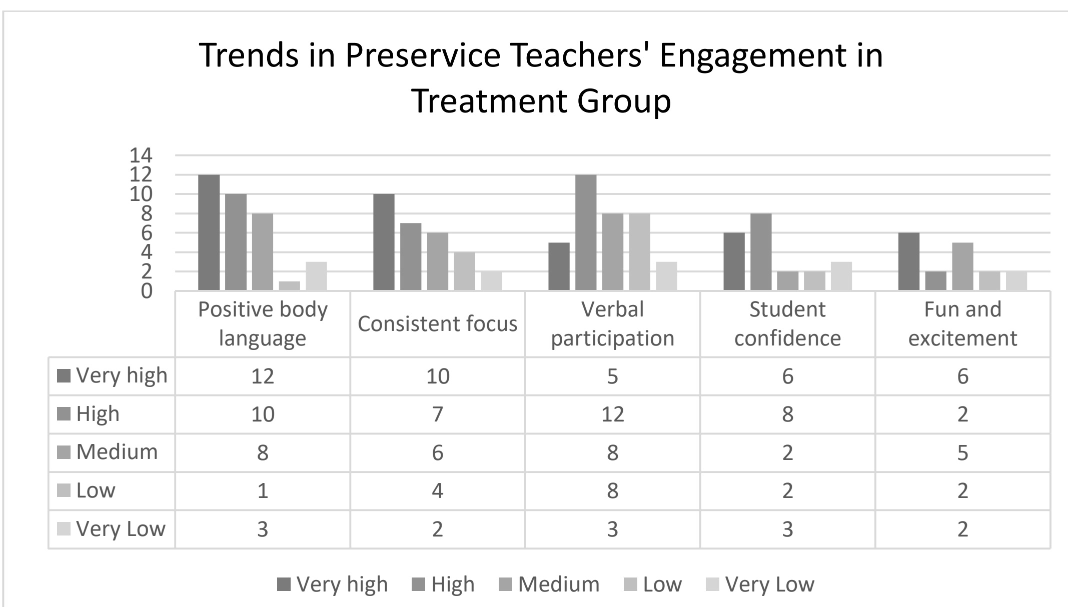



*Figure 5.5.* Trends in preservice teachers' engagement in treatment group

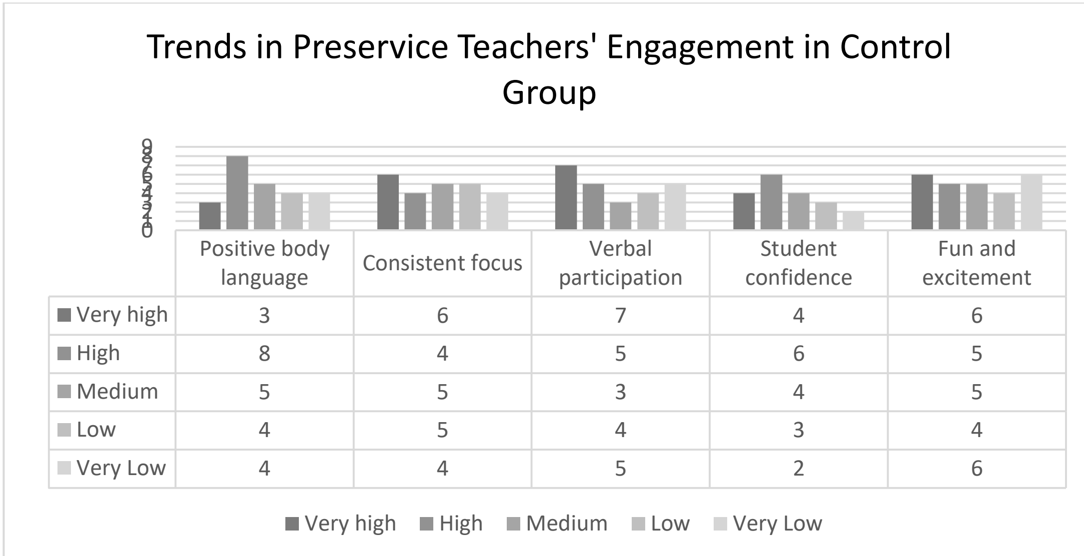



*Figure 5.6.* Trends in preservice teachers' engagement in control group

## Preservice Teachers' Learning Outcomes

Learning outcomes of PSTs were investigated based on their level of perceived knowledge and paper-based test.

**Preservice teachers' perceived knowledge.** Table 5.1 shows the mean (M) and standard deviation (SD) of all three cases.

Table 5.1

*Mean (M) and Standard Deviation (SD) of Pretest and Posttest for Treatment and Control Groups (N=28)*

| Cases | | Pretest | | Posttest | |
|---|---|---|---|---|---|
| | | M | SD | M | SD |
| 1 | Treatment (n=14) | 3.00 | .555 | 3.64 | .497 |
| | Control (n=14) | 2.71 | .469 | 2.86 | .143 |
| 2 | Treatment (n=14) | 3.43 | .514 | 3.93 | .267 |
| | Control (n=14) | 3.93 | .267 | 4.07 | .267 |
| 3 | Treatment (n=14) | 3.64 | .497 | 3.93 | .469 |
| | Control (n=14) | 3.71 | .469 | 3.86 | .535 |

Table 5.2 represents a paired *t* test analysis of the three cases. In Case 1, significant differences were not found in the scores between the treatment group (M = 3.00, SD = .555) and control group (M = 2.71, SD = .469), *t* (13) = 1.749, *p* = 0.104, *d* = 0.47. The effect size of this analysis was Cohen's *d* = 0.47 and was found to be a small effect *d* = 0.20. These results suggest that there were no differences in learning outcomes in the pretest between the treatment and control groups. The results also indicate that both the treatment and control groups were equal in ability for learning outcomes before a classroom instruction with technology-integrated instructions based on a TPACK-integrated ID model through *Worked Examples* (the term intervention is used throughout the chapter in the place of classroom instruction with technology-integrated instructions based on a TPACK-integrated ID model through *Worked Examples*).

However, statistical significance was found in the test scores of the pretest (M = 3.00, SD = 0.555) to posttest (M = 3.64, SD = 0.497), *t* (13) = -3.798, p = .002, *d* = 1.01. The effect size for this analysis was Cohen's d = 1.01 and was found to exceed Cohen's (1988) convention for a large effect (d = 0.80). These results suggest that the PSTs in the treatment group performed significantly better in the posttest than in the pretest. It also indicates that the treatment group which gained classroom instruction based on an intervention was large in effect size. Further, the pretest and posttest for the control group were compared as pair 2. The analysis shows that there was no statistically significant difference in the scores for the pretest (M = 2.71, SD = 0.469) and posttest (M = 2.86, SD = 0.143), *t* (13) = -1.472, p = 0.165, d = 0.39. The size for this analysis was Cohen's d = 0.39 and was found as a small effect (*d* = 0.20). These results suggest that the effect of the perceived knowledge was also small.

Table 5.2

*Paired t Test of Pretest and Posttest of Treatment and Control Groups (N=28)*

| Paired t test | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cases** | | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | *T* | *df* | Sig. (2-tailed) |
| | | | | | | Lower | Upper | | | |
| **1** | Pair | Pretest-treatment-pretest-control | -.286 | .611 | .163 | -.067 | .639 | 1.749 | 13 | .104 |
| | Pair1 | Pretest-treatment-posttest-treatment | -.643 | .633 | .169 | -1.009 | -.277 | -3.798 | 13 | **.002**** |
| | Pair2 | Pretest-control-posttest-control | -.143 | .363 | .097 | -.353 | -067 | -1.472 | 13 | .165 |
| **2** | Pair1 | Pretest-treatment-posttest-treatment | -.500 | .519 | .139 | -.800 | -.200 | -3.606 | 13 | **.003**** |
| | Pair2 | Pretest-control-posttest-control | .143 | .363 | .097 | -.353 | .067 | -1.472 | 13 | .165 |
| **3** | Pair1 | Pretest-treatment-posttest-treatment | -.286 | .611 | .163 | -.639 | .067 | -1.749 | 13 | .104 |
| | Pair2 | Pretest-control-posttest-control | -.143 | .663 | .177 | -.526 | .240 | -.806 | 13 | .435 |

In Case 2, the pretest score of the treatment group (M = 3.43, SD = 0.514) to posttest (M = 3.93, SD = 0.267), *t*(13) = -3.606, p = 0.003, *d* = 0.96 revealed that there was a statistically significant difference with a large effect compared to the pretest score of the control group (M = 3.93, SD = 0.267) to posttest (M = 4.07, SD = 0.267), *t*(13) = -1.472, p = 0.165, *d* = 0.39, which showed that there was no significant difference and effect size was also small. There findings show that an intervention could bring a huge change in perceived knowledge of PSTs.

Similarly, in Case 2, the pretest score shows that there was no statistical difference in the test scores from the pretest (M = 3.64, SD = 0.497) to posttest (M = 3.93, SD = 0.469), *t* (13) = -1.749, p = 0.104, *d* = 0.46 in treatment group, and test scores from the pretest (M = 3.71, SD = 0.469) to posttest (M = 3.86, SD = 0.535), *t* (13) = -0.806, p = 0.435, *d* = 0.21.The effect size revealed that even if the differences were not found to be statistically significant, the level of knowledge perceived by treatment group was high.

**Preservice teachers' paper-based test.** The study involved three different cases and the mean scores of the paper-based test of Cases 1, 2 and 3 were measured to identify the specific content knowledge of the PSTs among the treatment and control groups. Table 4.3 represents the paper-based test scores; PSTs in the treatment group secured higher test scores in the posttests compared to that of the pretests. For instance, PSTs from the control treatment group scored 10% (pretest) to 67% (posttest) in Case 1, 15% (pretest) to 78% (posttest) in Case 2 and 18% (pretest) to 61% (posttest) in Case 3.

Accordingly, the increase in test scores was also found in the control group of PSTs. For example: 15% (pretest) to 31% (posttest) in Case 1; 19% (pretest) to 43% (posttest) in Case 2; and 19% (pretest) to 51% (posttest) in Case 3. These results indicate that the PSTs under the treatment group appeared to perform better than that of the control group. These findings justify that the PSTs had performed better based on an intervention.

Table 5.3
*Paper-based Test Scores*

| **Cases** | **Treatment group** | | **Control group** | |
|---|---|---|---|---|
| | Pretest (%) | Posttest (%) | Pretest (%) | Posttest (%) |
| 1 | 10 | 67 | 15 | 31 |
| 2 | 15 | 78 | 19 | 43 |
| 3 | 18 | 61 | 19 | 51 |

**Preservice Teachers' Knowledge Transfer**

Transformation of knowledge refers to the carryover effect of learning experiences by PSTs gained in the TEP program during teaching practices. It was investigated to know the readiness of PSTs because the key purpose of TEP program is to prepare competent instructors. Among the four PSTs, three of them (PST-1, PST-3, PST-4) were from the treatment group and one (PST-2) was from the control. PST-1 and PST-3, who belonged to Case 1 and 2 respectively utilized various technological resources available in the school. PST-1 and PST-3. Further, they employed pedagogical strategies such as quizzes, open questions, and class discussions.

In the context of PST-2 (from the control group), his instructional strategies included the current events of the society during classroom instruction to obtain the attention from students. However, he lacked interaction during his teaching which signified that his teaching strategy was instructor-centered. In the context of PST-1, she integrated the various technologies such as *smartphones, a big screen, and Chromecast*, to gain the attention from the students. Further, she divided the classroom into two groups and conducted quizzes simultaneously among them. Accordingly, PST-3 emphasized open questions among students that related with the content of the course and used offline YouTube videos to provide detailed information about the topics.

Similarly, PST-4 used PowerPoint slides to deliver her lesson content to the students. In her class, the interactions were found to be very low because students never had a chance to speak up and she focused on the contents of the course. Based on the class observations, PSTs who were trained based on a TPACK-integrated ID model through *Worked Examples* were able to develop competencies to integrate technology with appropriate pedagogical strategies to teach the required contents compared to the training based on the usual classroom instruction. The teaching practice shows that various pedagogical strategies and technological resources differ based on the content that needs to be taught in the school classroom.

### Preservice Teachers' Self-efficacy toward Technology Integration

Table 5.4 shows the mean (M) and standard deviation (SD) of all three cases.

Table 5.4
*Mean (M) and Standard Deviation (SD) of Pretest and Posttest for Treatment and Control Groups*

| Cases | | Pretest | | Posttest | |
|---|---|---|---|---|---|
| | | M | SD | M | SD |
| 1 | Treatment (n=14) | 2.70 | .715 | 3.76 | .428 |
| | Control (n=14) | 2.75 | .435 | 2.74 | .218 |
| 2 | Treatment (n=14) | 3.69 | .499 | 4.64 | .101 |
| | Control (n=14) | 4.00 | .138 | 4.08 | .358 |
| 3 | Treatment (n=14) | 2.70 | .715 | 3.76 | .435 |
| | Control (n=14) | 2.75 | .428 | 2.83 | .274 |

Table 5.5 represents a paired *t* test analysis of the three cases. In Case 1, there was no significant difference between pretest between treatment and control groups $t$ (13) = 0-.205, p = 0.840, $d$ = 0.54. This represents that the PSTs from both groups possessed the same level of self-efficacy before an intervention. In the treatment group, the test scores of pretest (M = 2.70, SD = 0.715) to posttest (M = 3.76, SD = 0.428), $t$ (13) = -1.278, p = 0.001, d = 1.13, represents that there was a significant difference with a large effect. However, a statistically significant difference was not found in the test scores of pretest (M = 2.75, SD = 0.435) to posttest (M = 2.74, SD = 0.218), $t$ (13) = 0.067, p = 0.947, $d$ = 0.01.

Table 5.5

*Paired t Test of Pretest and Posttest of Treatment and Control Groups*

| Paired *t* test | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cases** | | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | *t* | *df* | Sig. (2-tailed) |
| | | | | | | Lower | Upper | | | |
| **1** | Pair | Pretest-treatment-pretest-control | -.050 | .910 | .243 | -.575 | .475 | -.205 | 13 | .840 |
| | Pair1 | Pretest-treatment-posttest-treatment | -1.06 | .933 | .249 | -1.60 | -.528 | -4.278 | 13 | **.001**** |
| | Pair2 | Pretest-control-posttest-control | .007 | .397 | .106 | -.222 | .236 | .067 | 13 | .947 |
| **2** | Pair1 | Pretest-treatment-posttest-treatment | -.946 | .542 | .145 | -1.25 | -.633 | -6.526 | 13 | **.000**** |
| | Pair2 | Pretest-control-posttest-control | -.078 | .430 | .115 | -.327 | .170 | -.682 | 13 | .507 |
| **3** | Pair1 | Pretest-treatment-posttest-treatment | -1.06 | .933 | .249 | -1.60 | -.528 | -4.278 | 13 | **.001**** |
| | Pair2 | Pretest-control-posttest-control | -.082 | .381 | .101 | -.302 | .137 | -.806 | 13 | .434 |

In Case 2, the pretest score of the treatment group (M = 3.69, SD = 0.499) to posttest (M = 4.64, SD = 0.101), *t* (13) = -6.526, p = 0.000, *d* = 1.74 revealed that there was a significant difference statistically with a large effect size. However, the pretest score of the control group (M = 4.00, SD = 0.138) to posttest (M = 4.08, SD = 0.358), *t* (13) = 0.682, p = 0.507, *d* = 0.18 showed that there was no significant difference and the effect size was also small. The finding of Cases 1 and 2 shows that classroom instruction based on an intervention could make a significant difference in bringing changes in the self-efficacy toward technology integration having a large effect size.

Similarly, in Case 2, the pretest score of the treatment group (M = 2.70, SD = 0.715) to posttest (M = 3.76, SD = 0.435, *t* (13) = -4.278, p = 0.001, *d* = 1.1, showed statistically that there was a significant difference compared to the pretest and posttest scores of the treatment group having a large effect size. However, pretest test scores of the control group (M = 2.75, SD = 0.428) to posttest (M = 2.83, SD = 0.274), *t* (13) = -0.806, p = 0.434, *d* = 0.21, revealed that there was no statistically significant difference. Thus, this analysis signifies that typical usual classroom instruction might not bring a significant change in the self-efficacy of PSTs and if brought the changes were small.

**Preservice Teachers' Attitude toward Technology**

Table 5.6 represents the mean and standard deviation of a PST's attitude toward technology among the three different cases.

Table 5.6
*Mean (M) and Standard Deviation (SD) of Pretest and Posttest for Treatment and Control Groups*

| Cases | | Pretest | | Posttest | |
|---|---|---|---|---|---|
| | | M | SD | M | SD |
| 1 | Treatment (n=14) | 3.36 | .842 | 4.07 | .267 |
| | Control (n=14) | 3.29 | .469 | 3.57 | 1.10 |
| 2 | Treatment (n=14) | 3.14 | .143 | 4.07 | .267 |
| | Control (n=14) | 3.93 | .267 | 4.07 | .475 |
| 3 | Treatment (n=14) | 2.79 | .802 | 3.43 | .938 |
| | Control (n=14) | 3.57 | .514 | 3.36 | .745 |

Table 5.7 represents a paired *t* test analysis of the three cases. In Case 1, a statistically significant difference was not found between pretest between treatment and control groups *t* (13) = .601, p = 0.775, *d* = 0.077. This represents that the PSTs from both groups possessed the same level of attitude toward technology before an intervention. In the treatment group, the test scores of the pretest (M = 3.36, SD = 0.842) to posttest (M = 4.07, SD = 0.267), *t* (13) = -2.687, p = 0.019, *d*

= 0.71, represents that there was a significant difference having a medium effect. However, statistically significant differences were not found in the test scores of pretest (M = 3.29, SD = 0.469) to posttest (M = 3.57, SD = 1.10), *t* (13) = -0.888, p = 0.391, *d* =.023. This analysis shows that TEP instructors' teaching based on an intervention could make a significant difference in changing the attitude of PSTs toward technology with a medium change effect.

Table 5.7

*Paired t Test of Pretest and Posttest of Treatment and Control Groups*

| Cases | | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference: Lower | 95% Confidence Interval of the Difference: Upper | *t* | *df* | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pair | Pretest-treatment-pretest-control | -.071 | .917 | .245 | -.458 | .475 | .601 | 13 | .775 |
| **1** | Pair1 | Pretest-treatment-posttest-treatment | -.714 | .994 | .266 | -1.288 | -.140 | -2.687 | 13 | **.019*** |
| | Pair2 | Pretest-control-posttest-control | -.286 | 1.204 | .322 | -.981 | .410 | -.888 | 13 | .391 |
| **2** | Pair1 | Pretest-treatment-posttest-treatment | -.929 | .616 | .165 | -1.284 | -.573 | -5.643 | 13 | **.000**** |
| | Pair2 | Pretest-control-posttest-control | -.143 | .663 | .177 | -.526 | .240 | -.806 | 13 | .435 |
| **3** | Pair1 | Pretest-treatment-posttest-treatment | -.643 | .842 | .225 | -1.129 | -.157 | -2.857 | 13 | **.013*** |
| | Pair2 | Pretest-control-posttest-control | .214 | .426 | .114 | -.302 | .460 | 1.883 | 13 | .082 |

In Case 2, the pretest score of the treatment group (M = 3.14, SD = 0.143) to posttest (M = 4.07, SD = 0.267), *t* (13) = -5.643, p = 0.000, *d* = 1.50 revealed that there was a statistically significant difference with a large effect change compared to the pretest score of the control group (M = 3.93, SD = 0.267) to posttest (M = 4.07, SD = 0.475), *t* (13) = -0.806, p = 0.435, *d* = 0.21 showed that there was no significant difference and the effect size was also small. These findings shows that technology-integrated instructions based on a TPACK-integrated ID model through *Worked Examples* could bring large changes on attitudes of PSTs toward technology with a large effect.

Similarly, in Case 3, the pretest score of the treatment group (M = 2.79, SD = 0.802) to posttest (M = 3.43, SD = 0.938, $t$ (13) = -2.857, p = 0.013, $d$ = 0.763, showed statistically that there was a significant difference compared to the pretest and posttest scores of the treatment group with a medium size effect. However, pretest test scores of the control group (M = 3.57, SD = 0.514) to posttest (M = 3.36, SD = 0.745), $t$ (13) = 1.883, p = 0.082, $d$ = 0.50, revealed that there was no statistically significant difference. Thus, this analysis signifies that instruction based traditional classroom instruction might not bring a significant change in the attitude of PSTs toward technology and if brought the changes were also medium.

# Chapter 6: Discussions

This study attempted to develop and validate a TPACK-integrated ID model in a TEP to assist TEP instructors in creating and implementing technology-integrated instructions. In addition, it offered *Worked Examples* to demonstrate the application of a TPACK-integrated ID model by providing the set of guidelines to address the extraneous cognitive load of TEP instructors. *Worked Examples* were provided to utilize (i) key phases and key components of a TPACK-integrated ID model, and (ii) content, pedagogy, and technology for creating technology-integrated instructions for classroom instruction.

The study was conducted in the Nepalese context for investigating how TEP instructors had utilized a TPACK-integrated ID model through *Worked Examples* in implementing technology integration in the classroom. Additionally, the study examined learning experiences of PSTs for the purpose of improving a TPACK-integrated ID model and *Worked Examples*.

In this chapter, the discussion is presented based on the key findings of the study and relevant pieces of literature under four major themes: (i) technology integration model, (ii) newly added *Explore* phase, (iii) structure for scaffolding process with *Worked Examples*, and (iv) mitigating the barriers to technology integration. At the end of the discussion, an elaborated TPACK-integrated ID model was presented for further study.

## Technology Integration Model

As discussed in the literature, various ID models and framework such as ASSURE, Kemp, SAMR, TPACK, and TPACK-based ID have been employed to design, development and implement technology-integrated instruction. However those ID models and framework possessed such major limitations as (i) need of instructors' awareness regarding ID models, (ii) demand for an expert guidance to utilize the various steps of ID models, (iii) increased time and financial burden to the educational institutions, (iv) lack of detailed guideline for instructors to implement SAMR model, (v) shortage of structural descriptions for creating lesson plans by integrating content, pedagogy, and technology based on TPACK, and (vi) exclusive focus on enhancing TPACK knowledge of PSTs, if implement TPACK-based ID that doesn't not guarantee to bring technology integration.

In the present study, a TPACK-integrated ID model was developed based on a systems thinking approach, generic ID process, and a TPACK framework, and validated in the context of Nepalese TEP. Findings revealed that this TPACK-integrated ID model through *Worked Examples* assisted TEP instructors in creating technology-integrated lessons by incorporating content, pedagogy, and technology simultaneously. Additionally, *Worked Examples* helped TEP instructors to utilize a TAPCK-integrated ID model independently.

As highlighted by Arnold and Wade (2015), systems thinking approach is the process to achieve a goal that can be achieved by focusing on the purpose, elements, and interconnections. The findings of the present study showed that a TPACK-integrated ID model assisted TEP instructors having various levels of knowledge regarding content, pedagogy, and technology in creating technology-integrated lessons efficiently during classroom instructions. It was found to be useful for TEP instructors in investigating relevant multifarious elements needed to blend their CK, PK, and TK simultaneously, which was a result of a systems thinking approach.

As argued by Bingimlas (2009), instructors with low levels of technological knowledge often experience difficulties in creating and implementing technology-integrated instructions, which was strongly assumed to be the case in the context of developing countries. However, the present study revealed that with the proper help of procedural knowledge using a TPACK-integrated ID model through *Worked Examples*, TEP instructors with low knowledge and skills in terms of technologies were able to successfully create and implement technology-integrated instructions for classroom instructions. Therefore, the findings of the present study contradicted those of the previously mentioned study done by Bingimlas (2009). There might be various reasons behind this contradiction such as a study by Vatanartiran and Karadeniz (2015) in a Turkish context which highlighted that instructors' planning in terms of infrastructural and instructional strategies was also crucial for creating and implementing technology integration because their efforts should not be limited to their technological knowledge alone. Therefore, the authors recommended that the analyzing various options such as instructional materials, support, and alternatives could be profitable for bringing out technology integration in the practice.

Further, Okojie, Olinzock, and Okojie-Boulder (2006) highlighted that instructors' pedagogical knowledge for linking with technological knowledge and resources is crucial for technology integration. They strongly argued that adequate technological resources and instructors' technological knowledge alone should not be considered as the major elements to technology integration because pedagogical strategies were also found to be crucial for creating and implementing technology-integrated instructions. The finding of the present study confirmed

Okojie et al.'s argument, found that an investigation done by the TEP instructors through *Worked Examples* was also not limited to the technological resources. *Worked Examples* assisted TEP instructors to confirm the possibilities in the *Explore* phase for utilizing various resources based on the investigations regarding technology, content, and human support in creating and implementing technology-integrated instructions.

### Explore Phase

Even if the ADDIE model includes a needs analysis in its *Analyze* phase to determine constraints and resources before carrying out the *Design* phase, it still lacks the specific phase to confirm possible opportunities in investigating those resources, which are crucial for creating and implementing technology-integrated instructions especially in the context of developing countries for technology integration. Therefore, while developing a TPACK-integrated ID model, an *Explore* phase was added to reassert the resources in terms of content, technology, and supports before the *Design* phase for assisting TEP instructors in creating and implementing technology-integrated instructions.

Models and framework like ASSURE, Kemp's, SAMR, TPACK, and TPACK-based ID models provide the various phases in designing and developing technology-integrated instructions. However, as discussed in the literature review, those phases were not sufficient for instructors with low competencies, especially those from developing countries for technology integration. As argued by ChanLin (2005) and Christensen and Knezek (2006) even if various elements were responsible for technology integration, detailed information in terms of the content of the course and confirming technological resources, and administrative support are also crucial for instructors' having low competencies.

Based on the findings of the study, three TEP instructors created technology-integrated instructions in the *Develop* phase by confirming the availability of resources (content, technology, and human) via the *Explore* phase. As recommended by the Center for Education Innovations (2014) and Rijal (2013), a country like Nepal, which has been solely relying on international donors and government funding, does not guarantee to have significant technological resources in Nepalese educational institutions. Under such circumstances, *Explore* phase can relieve the scarcity of technological resources especially in the developing countries because TEP instructors could seek possible opportunities in practicing technology integration through this phase.

In the present study, TEP instructors became more comfortable with this phase because, even if, they experience the anxiety in integrating technologies, *Explore* phase assist them to overcome with such anxiety by providing opportunities for investigations regarding technologies, contents, and supporting from the educational institutions. Based on the interviews with TEP instructors, such opportunities encourage them to practice technology integration by utilizing their existing technical competency, such as assembling social media in group work, mobile applications in vocabulary learning. Even more, observations revealed that TEP instructors became more competent and efficient in bringing out technology integration as well as their pedagogical strategies. A case study was done by Pierson (2014) also revealed that an effort invested by instructors in technology integration well as enhance the pedagogical strategies, which further improve the quality of instructions.

In addition, observations of the present study highlighted that *Explore* phase was not often used by the TEP instructors during the later stage of the interventions if compared with an initial phase. To investigate the causes behind this, interviews were done, which pointed out that TEP instructors became confident regarding the required task that needs to be done in creating and implementing technology-integrated instructions. In addition, TEP instructors explained that they could easily accommodate information, which was previously explored. It clarified that repetition same process also progress the confidence level, which was also discussed by a study done by Ertmer and Ottenbreit-Leftwich (2010) regarding the necessity of instructors' confidence in technology integration. Also, Renkl (2005) pointed out that *Worked Examples* can be very effective for practicing similar process intensively.

## Worked Examples

As discussed in Chapter 2, several studies suggest that *Worked Examples* is an effective instructional strategy to explain the several steps for novices (Clark, Nguyen, Sweller, 2006; Renkl, 2005; Salden, Aleven, Schwonke, Renkl, 2008). In the present study *Worked Examples* were offered to assist TEP instructors with (i) following various phases of a TPACK-integrated ID model and (ii) creating technology-integrated instruction found to be very effective as self-guided instructions. This finding reinforces the belief of Chi, Bassok, Lewis, Reimann, and Glaser (1989) and Kalyuga, Chandler, and Sweller (2000) that highlighted the idea that *Worked Examples* actively explained how to accomplish the tasks. Even more, Renkl (2005) added that both active and passive instructors need to be active with self-paced instructions such as *Worked Examples* in addressing an extraneous cognitive load.

The present study revealed that *Worked Examples* with various chunks in terms of key phases and key components assist TEP instructors in creating and implementing technology-integrated instructions in carrying out technology integration during classroom instruction. As highlighted by Alber (2011), providing support by breaking information into the chunks is a crucial step for achieving concrete structure. The process of breaking such instructions into the chunks is termed as scaffolding (Alber, 2011). This concept was initially carried out by Wood, Bruner, and Ross (1976) in learning, who define it as a process to enable a novice in achieving a goal via self-guided instructions.

As discussed in the literature various elements need to be considered in implementing technology integration, however, technology integration models and framework discussed in the literature lacks such scaffolding. Even more, as argued by Collis, Mcnaughton, Oliver, and Winnips (1999) and Kim and Hannafin (2011), scaffolding is a form of a temporary support for assisting with the process of becoming a skilled and creative practitioner. This is why even the various phases and knowledge outlined by previous models and framework were still found to be complicated in developing countries because, as highlighted by Chen (2008) lacking temporary support to the instructors can also hinder technology integration along with addressing their extraneous cognitive load.

Furthermore, the study revealed that *Worked Examples* also save time in creating and implementing technology-integrated instructions, even for TEP instructors with low technological competencies. The study done by Bauer and Kenton (2005) highlighted that instructors were not carrying out technology integration even if they were highly educated, skilled with technology and capable of overcoming obstacles because they still needed extra time for creating and implementing technology-integrated instructions. Thus *Worked Examples* can assist instructors to practice technology integration.

As highlighted by Renkl (2005), *Worked Examples* consist of a well-structured step in accomplishing the final goal. Even more, Van Gog, Kester and Paas (2011) revealed that instructors can develop their skills to produce several strategies based on a well-structured step provided by *Worked Examples*. In the present study, findings from observations revealed that TEP instructors, design and develop the technology-integrated instructions including materials simultaneously instead of accomplishing in two phases as prescribed by *Worked Examples*. In addition, findings from the interviews also revealed that since the present study provided *Worked Examples* having the integration of texts and diagrams assisted TEP instructors to bring out such strategies, which was also found by Tabbers, Martens, and van Marrenboer (2000) and highlighted that such integration of text and diagrams are the key characteristics of an effective *Worked Examples*.

## Mitigating Barriers to Technology Integration

In the study, three types of barriers to technology integration for the classroom instruction were discussed as first-order, second-order, and third-order. The first-order barrier is external factors that include a lack of the adequate resources, time, training, and institutional support. A second-order is personal beliefs, which are more instructor-centered and relate to the instructors' attitude toward technology integration, which consists of instructors' self-efficacy toward technology integration and attitude toward technology. Similarly, a third-order level covers instructors' competencies in designing and developing technology-integrated instructions for classroom instruction.

**First-order barriers**: **Lack of resources, time, training, and institutional support**

As highlighted by Khan et al., (2012) first-order barriers are the primary difficulties that hinder the technology integration in the context of developing countries like in Nepal. In the study, a newly added *Explore* phase was added that aimed to provide the opportunities for TEP instructors for exploring the possibilities of available resources. Based on the findings, even if the *Explore* phase was not able to address the first-order barriers comprehensively, it still assisted the TEP instructors' awareness about resources in terms of content, technology, and human, which provided the possible choices to TEP instructors based on their competencies for carrying out technology integration during classroom instruction before proceeding to the *Design* and *Develop* phase.

The finding of the study revealed that three TEP instructors with diversified competencies in terms of content, pedagogy, and technology were able to created and implemented technology-integrated instructions by investigating various opportunities for utilizing resources through the *Explore* phase. Among which, depending on the nature and objective of the content, TEP instructors delivered an instruction through deductive and inductive approaches. As argued by Prince and Felder (2007), a deductive approach (also known as instructor-centered), occurs when the instructor delivers an instruction to the learners about a new concept with an explanation and then learners complete certain activities. In contrast, in an inductive approach (also known as learners-centered) the instructors deliver an instruction based on some activities among the learners. As found by Felder and Silverman (1988) and Shaffer (1989) an inductive approach has been practiced for non-technical subjects and a deductive approach was carried out for technical subjects. As it relates to the present study, TEP instructor-1 and TEP instructor-

2 practiced an inductive approach whereas TEP instructor-3 adopted a deductive approach because of the nature of the subject.

**Second-order barriers: Instructors' attitudes toward technology integration**

The second-order barriers are instructor-centered and relate to the instructors' attitudes toward technology integration. As discussed in the literature, the instructors' self-efficacy toward technology integration and attitude toward technologies are responsible for the instructors' attitudes toward technology integration (Shirvani, 2014; Wang et al., 2004).

As argued by Harries and Sullivan (2000), instructors' attitude toward technology integration changes in two ways while carrying out technology integration. Initially, instructors thought to replace technologies from traditional (chalks, televisions etc.) to digital (computers, internets etc.) and secondly their perceptions of changing instructional strategies that include pedagogies, instructors' role etc. As argued by Duhaney (2001), instructors experience an extraneous cognitive load in such circumstances that also influence their willingness to integrate technology. However, in the present study, an in-depth investigation was not executed with TEP instructors in terms of attitude toward technology integration but the survey was carried out with PSTs to determine the changes carried out because of TEP instructors' technology-integrated instructions.

The surveys in terms of PSTs regarding self-efficacy toward technology integration and attitudes toward technologies revealed that their attitudes toward technology integration also relied on the instructors' instructions that might be technology-integrated (based on the model through Worked Examples) or typical instruction along with the PSTs' technological ownership, technical competencies, and teaching experiences. These findings also reinforce the beliefs of Wright, Wilson, Gordon, and Stallworth (2002) who recommended a new course named Master of Technology Teacher to prepare the future instructors for technology integration. Similar recommendations were also revealed by the study conducted by Jacobsen, Clifford, and Friesen (2002) in practice for designing and developing technology-integrated instructions to the PSTs in a TEP.

**Third-order barriers: Instructors' competencies in creating technology-integrated lessons**

Mumtaz (2000) highlighted that instructors' knowledge and skills for creating technology-integrated instructions are crucial in implementing technology integration along with resources. As pointed by Tsai and Chai (2012), even if both the first-order and second-order barriers are addressed, technology integration might not happen because instructors still need to have such competencies as (i) considering content, pedagogy, and technology simultaneously and (ii) reconfirming technology, in creating technology-integrated instructions. Tsai and Chai (2012) further elaborated that every classroom and group of learners were unique, so instructors need to have the necessary competencies for carrying out technology integration in classrooms actively and fluently, which was also revealed by a study done by Mumtaz (2000). To achieve such competencies among TEP instructors that could minimize the gap between the *required and actual competencies of TEP instructors*. *Worked Examples* developed in the present study can be one of the instructional strategies to address such gap.

The TEP instructors from different departments educated PSTs with technology-integrated instructions utilizing available technological resources with various pedagogical strategies through *Worked Examples*. As argued by Atkison et al. (2000), even if the instructors were not confident in accomplishing complex tasks, *Worked Examples* could assist them to integrate various elements for self-thinking. Since *Worked Examples* coincide with early stages of skill development, thus such *Worked Examples* also helps to develop the creativity and thinking process of the instructors (Atkison et al., 2000 & Karpicke & Aue, 2015).

Furthermore, the finding of the present study revealed that PSTs' engagement and enthusiasm in the classroom were observed to be high during technology-integrated instructions. This is consistent with the findings from other studies. For example, a study was done by Smith, Sheppard, Johnson, and Johnson (2005) and another, a study done by Abdullah, Bakar, and Mahbob (2012) found that PSTs' active participation in the classroom helps to enhance their confidence that further led toward their improved academic performance.

## An Elaborated TPACK-integrated ID Model for Further Study

The main purpose of the study was to develop and validate a TPACK-integrated ID model in a Nepalese TEP for assisting TEP instructors in creating and implementing technology-integrated instructions for carrying-out technology integration. To achieve this purpose, the study adopted *Design and Development* research consisting of a TPACK-integrated ID model for the pilot study and then revised a TPACK-integrated ID model for the main study. To improve a TPACK-integrated ID model, the study offered an elaborated TPACK-integrated ID model (Figure 6.1) based on the findings and discussions of the main study for further study.

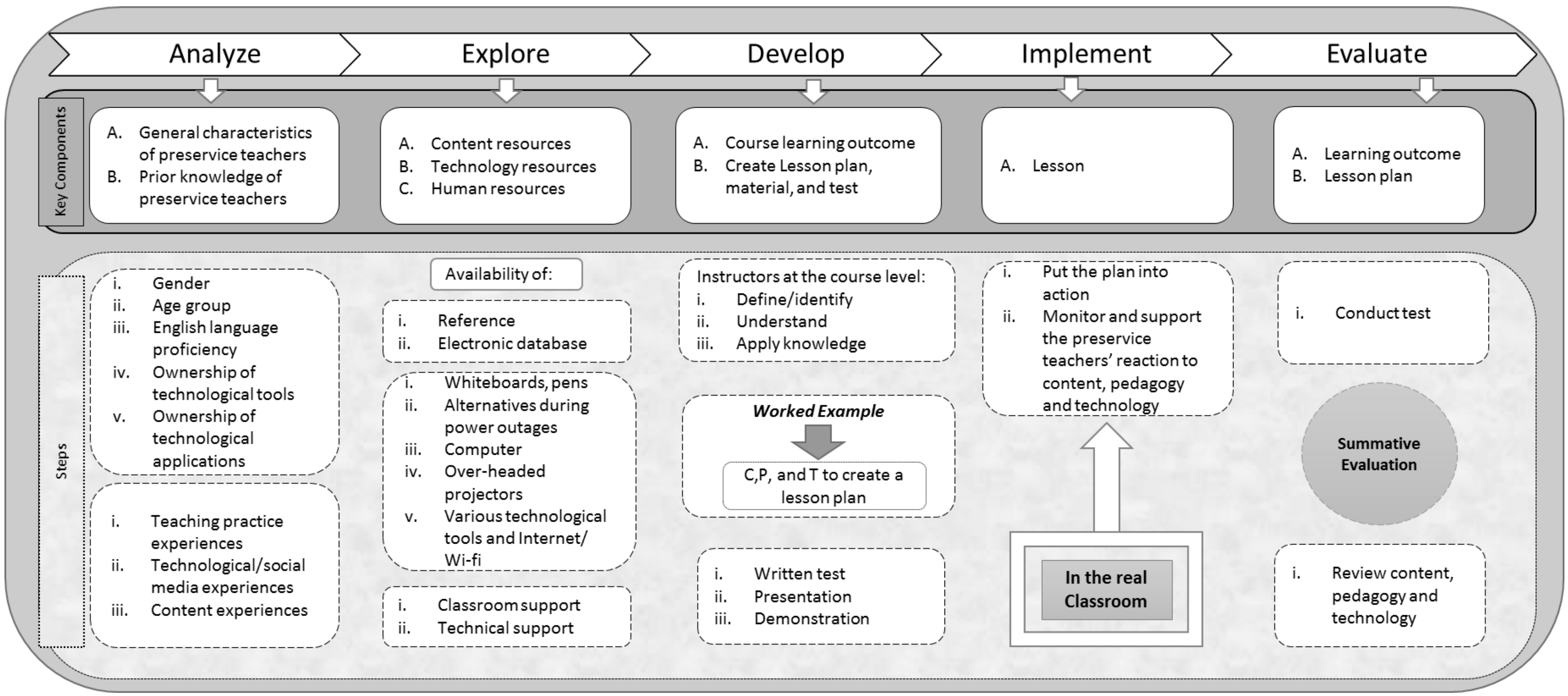



*Figure 6.1.* An Elaborated TPACK-integrated ID Model for the Further Study

In an elaborated TPACK-integrated ID model, the following key phases and components were modified if compared with a revised TPACK-integrated ID model:

(i) The *Design* and *Develop* phases were merged together and named as the *Develop* phase. In the main study, the TEP instructors were found to be confused about several key components in both phases because of having the same *Worked Examples* to design and develop technology-integrated instructions for the *Implement* phase. Thus, in the *Develop* phase of an elaborated TPACK-integrated ID model, several key components under the *Design* and *Develop* phase of a revised TPACK-integrated ID model were merged together with three key components. Such key components are (i) course learning outcome, (ii) create a lesson plan and materials, and (iii) test. To accomplish these three key components under the *Develop* phase, seven steps were provided as demonstrated in Figure 5.1.

(ii) Monitoring PSTs' reaction to content, pedagogy, and technology under the *Implement* phase was added based on the interviews with three TEP instructors and classroom observations. Support from TEP instructors to PSTs was revealed during classroom instructions but TEP instructors' regular monitoring toward PSTs' reaction to pedagogy and technology was not observed. Additionally, TEP instructors realized that they were not able to monitor PSTs' reaction because of time constraints. Further, PSTs' reaction in terms of content could also be revealed during the test under the *Evaluate* phase. Thus, monitoring PSTs' reactions to content, pedagogy, and technology was removed from the *Implement* phase.

In alignment with these changes in the elaborated TPACK-integrated ID model, necessary modifications were made in the *Worked Examples* (see Appendix 12).

# Chapter 7: Conclusion

This chapter covers the conclusion of the study. It goes on to explain the contributions including the theoretical and practical implications of the study along with the limitations and suggestions for future research.

## Conclusion

As highlighted by Mishra and Koehler (2006), content, pedagogy, and technology are three major elements of technology integration which is referred to as a TPACK framework. As discussed in the literature, even if the ID models have been utilized to bring about technology integration, they were not purposefully developed for integrating technology. Even more, technology integration models and framework such as SAMR, TPACK, and TPACK-based ID models were still found to be complicated in bringing technology integration during classroom instructions.

The study developed and validated a TPACK-integrated ID model, which examined how TEP instructors utilize the various key phases and key components of a model through *Worked Examples* in utilizing such key phases/and components and also in creating technology-integrated instructions for classroom instructions. Findings of the study revealed that the TEP instructors having the diverse degree of competencies regarding content, pedagogy, and technology was successfully utilize the model through *Worked Examples.*

Based on the findings of the study, few conclusions were discussed below.

- *Worked Examples* utilizes in study assists TEP instructors to create and implement technology-integrated instructions by incorporating several key phases/and components for bringing technology integration. Thus, a structure such as *Worked Examples* for technology integration was very helpful even to the experienced instructors.

- Among the three order barriers to the technology integration, personal beliefs that was termed as a second-order barrier in the study could be address by educating PSTs by creating technology-integrated instructions. Such instructions can be create based on a TPACK-integrated ID model through *Worked Examples*. Thus, utilization of such model and *Worked Examples* can be profitable for TEP instructors themselves in addressing first-order/and second-order barriers and constructing positive personal beliefs toward technology integration among PSTs.

- *Design* and *Develop* are two major phases of an ID model. Such phases were also time-consuming that demands TEP instructors' efforts. A scaffolding process in utilizing a graphical model such as *Worked Examples* offer in the study also assist TEP instructors in minimizing their efforts by accomplishing *Design* and *Develop* phase simultaneously.

- In the context of developing countries, based on TPACK-integrated ID model, instructors could integrate technology by exploring possibilities of various resources.

## Contributions of the Study

The study adds new knowledge for technology integration and creates implications for TEP instructors and policymakers.

### Theoretical Contributions

The study offered a new ID model for technology integration in the context of developing countries in creating and implementing technology-integrated instructions. A new ID model was named as a TPACK-integrated ID model because content, pedagogy, and technology were integrated simultaneously throughout the ID process. The study was significant in four theoretical perspectives such as:

**Addition of an *Explore* Phase.** As discussed in the literature, even if the *Analyze* phase of previous models consisted of a needs analysis of resources regarding of contents, technologies, and support in creating and implementing technology-integrated instructions, the confirmation of those resources as per need did not exist among those models. Thus the *Explore* phase was added to assist the confirmation of the resources by exploring the possibilities before creating and implementing technology-integrated instructions.

**Utilization of *Worked Examples***. *Worked Examples* utilized in the study act as a scaffolding to chunk the instructions in (i) utilizing key phases and key components of a TPACK-integrated ID model and (ii) creating a technology-integrated lesson. As pointed out by Renkl (2005), such scaffolding addressed the extraneous cognitive load of instructors in technology integration. However, based on the relevant literature, such *Worked Examples* was still rare in carrying out technology integration, especially integrating content, technology, and pedagogy (three elements of TPACK) in a generic ID model.

**Integrating the *TPACK Framework and ID Model*.** Following generic TPACK-based ID models were discussed in the literature, which aims to educate PSTs about the TPACK framework based on the ID model. However, three key elements of TPACK (content, technology, and pedagogy) were not found to be utilized by TEP instructors in the classrooms. Thus Archambault and Shelton (2017) argued that instructors using TPACK are not guaranteed to carry out technology integration. In thus study, three elements of TPACK were integrated simultaneously throughout the process of the ID model in creating and implementing technology-integrated instructions. Such integration of a TPACK framework with an ID model was almost neglected in previous attempts at technology integration.

**Integrating *Design* and *Develop Phase*.** TPACK-integrated ID model contains specific strategies that assist instructors in accomplishing design *and develop phase* in creating technology-integrated instructions at same phase.

**Context of *Developing Countries*.** In the context of developing countries, efforts have especially focused on the technological resources and instructors' competencies in carrying out technology integration. However, studies and national evidence highlighted that those efforts were still not sufficient. Thus, the study provides a structure for creating and implementing technology-integrated instructions even to the instructors with low competencies, especially from developing countries. Even more, instructors have an opportunity to investigate the available resources through the *Explore* phase in carrying out technology integration based on their own competencies regarding content, pedagogy, and technology. Such a model and *Worked Examples* were also neglected in the context of developing countries by the date.

**Practical Contributions**

The study offers several implications for instructors and trainers among schools and universities. Even more, policymakers can also appreciate the findings of the study while reforming technology integration programs and policies in the future.

First, even if the study was carried out in a Nepalese TEP, instructors from any school and university can utilize a TPACK-integrated ID model in carrying out technology-integrated instructions through *Worked Examples*. Furthermore, instructors who would like to raise learners' engagement for improving academic performance by taking an advantage of the technology-integrated instructions.

Second, in the developing countries, lack of technological resources and low level of instructors' technical competencies are considered to be major hurdles to technology integration. However, a TPACK-integrated ID model provides the various phases in considering the possibilities of utilizing a diverse set of resources before designing and developing technology-integrated instructionss in the classroom.

Third, Bajracharya (2015) found that a low interactive classroom is one of the key hurdles contributing to school dropout in developing countries like Nepal. Thus, K-12 schools can utilize a TPACK-integrated ID model to address this problem. *Worked Examples* offered in the study to utilize a TPACK-integrated ID model can be considered as a tool to decrease the high rate of attrition by enhancing the interactive classroom by carrying out technology-integrated instruction. Further, the model showed the possibility of providing quality education by creating interactive instruction with various pedagogical strategies and utilizing available technologies to educate K-12 students.

Fourth, since the Nepalese government is continuously reforming existing training guidelines and related policies in carrying out technology integration through TEP, a TPACK-integrated ID model with *Worked Examples* can be considered in reforming those process to educate instructors by considering key phases and key components.

Fifth, even though the development and validation process was carried out in a Nepalese TEP, instructors from any country can utilize a TPACK-integrated ID model through *Worked Examples*. This is because *Worked Examples* can also be modified in the context regarding content, pedagogy, and technology in creating and implementing technology-integrated instructions.

## Limitations of the Study

While the study offers useful implications from a theoretical as well as a practical perspective as discussed above, its findings need to be interpreted with caution as discussed below.

First, a TPACK-integrated ID model was intended to assist TEP instructors in creating and implementing technology-integrated instructions. However, in the study, detailed investigations in terms of second-order barriers that concerned the TEP instructors' self-efficacy beliefs toward technology integration and attitude toward technology were not investigated by employing quantitative and qualitative instruments.

Second, since the TEP instructors associated in the study where quite experienced and had working anywhere from six to twelve years within the Nepalese TEP, different findings might be expected in the context of novice TEP instructors.

Third, although a TPACK-integrated ID model and *Worked Examples* were provided to the three TEP instructors, the individual efforts invested by each TEP instructor in utilizing key phases and components to create technology-integrated instructions were not studied in the study. Thus a time factor, which was important in technology integration, was hidden in the study among the TEP instructors regarding the content with selected pedagogical strategies and technological resources.

Fourth, the classroom observations were performed to observe the engagement level of PSTs during classroom instruction based on five components: positive body language, consistent focus, verbal participants, student confidence, and fun and excitement. However, as argued by James (2015), learners need to be cognitively engaged in the classroom for quality education, which was not examined based on those five components alone.

Fifth, it was not possible to have additional PSTs because the number of the PSTs who participated in the study was standard in the context of a Nepalese TEP. Thus, results can be varied if the study were carried out in different universities within Nepal or in other developing countries with more PSTs.

## Suggestions for Further Study

While the developed and validated TPACK-integrated ID model in this study holds promising prospects, it still requires further research to authenticate its application in varied contexts and with different educational goals.

First, further research can be done in rural Nepalese TEP to investigate how TEP instructors utilize key phases and key components of a TPACK-integrated ID model through *Worked Examples*, where resources regarding content, technology, and human support are much more inferior. Kafle (2007) also reported that instructors' competencies in terms of content, technology, and pedagogy were high in urban areas if compared with rural Nepal.

Second, since the TEP instructors created and implemented technology-integrated instructions through *Worked Examples* by confirming relevant resources that justify a TPACK-integrated ID model, they could address the first-order and third-order barrier to technology integration. However, second-order barriers related to the TEP instructors' attitude toward technology integration were not investigated in the study. Thus, validated instruments need to be considered for further investigations because they were strongly associated with the willingness of TEP instructors in technology integration.

Third, as found by Beasley and Sutton (1993), there is a gap regarding content knowledge and pedagogical knowledge among experienced and novice TEP instructors. All the TEP instructors associated with the present study were highly experienced. Thus, a comparative study among experienced and novice TEP instructors is recommended to investigate the effect of content knowledge and pedagogical knowledge in carrying out technology integration. Further, similar studies could also be performed among TEP instructors having mixed levels of technological ability.

## References


Abdullah, M. Y., Bakar, N. R. A., & Mahbob, M. H. (2012). Student's participation in classroom: What motivates them to speak up? *Procedia-Social and Behavioral Sciences*, *51*, 516-522. doi: https://doi.org/10.1016/j.sbspro.2012.08.199

Ajjan, H., & Hartshorne, R. (2008). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests. *The Internet and Higher Education*, *11*(2), 71-80. doi: https://doi.org/10.1016/j.iheduc.2008.05.002

Alber, R. (2011). Six scaffolding strategies to use with your students. *Teacher Leadership, 30*, 45-50.

Albion, P. R. (2001). Some factors in the development of self-efficacy beliefs for computer use among teacher education students. *Journal of Technology and Teacher Education*, *9*(3), 321-347.

Albirini, A. (2006). Teachers' attitudes toward information and communication technologies: The case of Syrian EFL teachers. *Computers and Education*, *47*(4), 373-398. doi: https://doi.org/10.1016/j.compedu.2004.10.013

Allinder, R. M. (1994). The relationship between efficacy and the instructional practices of special education teachers and consultants. *Teacher Education and Special Education*, *17*(2), 86-95. doi: 10.1177/088840649401700203

Almekhlafi, A. G., & Almeqdadi, F. A. (2010). Teachers' perceptions of technology integration in the United Arab Emirates school classrooms. *Journal of Educational Technology and Society*, *13*(1), 165-175.

Al-Zaidiyeen, N. J., Mei, L. L., & Fook, F. S. (2010). Teachers' attitudes and levels of technology use in classrooms: The case of Jordan schools. *International Education Studies*, *3*(2), 211-218. doi: http://dx.doi.org/10.5539/ies.v3n2p211

Amy, L.S. & Katina, M.L. (2014). The impact of technology on PK-12 teacher preparation programs. In V. Wang (Ed.), *Handbook of research on education and technology in a changing society* (pp. 235-245). Hershey, PA: Information Science Reference.

Anderson, J. (2010). *ICT transforming education: A regional guide.* Retrieved on September 17, 2014, from http://unesdoc.unesco.org/images/0018/001892/189216e.pdf

Appleton, J. J., Christenson, S. L., Kim, D., & Reschly, A. L. (2006). Measuring cognitive and psychological engagement: Validation of the student engagement instrument. *Journal of School Psychology*, *44*(5), 427-445.

Arnold, R. D., & Wade, J. P. (2015). A definition of systems thinking: a systems approach. *Procedia Computer Science, 44*, 669-678. doi: 10.1016/j.procs.2015.03.050

Aronson, D. (1998). *Overview of systems thinking*. Retrieved on November 3, 2017, from http://www.thinking.net/Systems_Thinking/OverviewSTarticle.pdf

Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. *Review of Educational Research*, *70*(2), 181-214.

Ayres, P., & Sweller, J. (2005). The split-attention principle in multimedia learning. In R. Mayer (Ed.), *Cambridge handbook of multimedia learning* (pp. 135-146). Cambridge: Cambridge University Press.

Bajracharya, D. (2015). Impact of teacher-student communication on "high-risk dropout" students. *Developing Country Studies, 5*(18), 88-101.

Bajracharya, D. (2018). *Determinant factors of dropout risk in primary education of Nepal: The case of the Kathmandu valley*. Unpublished doctoral dissertation, Ochanomizu University, Tokyo.

Bajracharya, J.R. (2015). *TPACK Survey for Nepalese preservice teachers*. Paper presented at the 19th International Conference on Education Research, Seoul, South Korea. Abstract retrieved on August 24, 2016, from http://www.icer.snu.ac.kr/contents/Down_Session2.asp

Bajracharya, J. R. (2017). Strength of traditional and social media in education: A review of the literature. *Journal of Research and Method in Education, 6*(6), 13-21.

Banathy, B. H. (1999). Systems thinking in higher education: Learning comes to focus. *Systems Research and Behavioral Science*, *16*(2), 133-145.

Bandura, A. (1995). Exercise of personal and collective efficacy in changing societies. In A. Bandura. (Ed.), *Self-efficacy in changing societies* (pp. 1-45). New York, NY: Cambridge University Press.

Baran, B. (2010). Experiences from the process of designing lessons with interactive whiteboard: ASSURE as a road map. *Contemporary Educational Technology*, *1*(4), 367-380.

Bauer, J., & Kenton, J. (2005). Toward technology integration in the schools: Why it isn't happening. *Journal of Technology and Teacher Education*, *13*(4), 519-546.

Beasley, W., & Sutton, R. (1993). Integration of computers in schools: Three levels of teacher expertise. *Journal of Computing in Teacher Education*, *9*(4), 11-15.

Betts, F. (1992). How systems thinking applies to education. *Educational Leadership, 50*(3), 38-41.

Bingimlas, K. A. (2009). Barriers to the successful integration of ICT in teaching and learning environments: A review of the literature. *Eurasia Journal of Mathematics, Science and Technology Education*, *5*(3), 235-245.

Bitner, N. & Bitner, J. (2002). Integrating technology into the classroom: Eight keys to success. *Journal of Technology and Teacher Education*, *10*(1), 95-100.

Botturi, L., Cantoni, L., Lepori, B., & Tardini, S. (2006). Fast prototyping as a communication catalyst for e-learning design. In T. Lawrence (Ed.), *Online and distance learning: Concepts, methodologies, tools, and applications* (pp. 1014-1027). New York, NY: Information Science Reference.

Branch, R., & Merrill, M.D. (2011). Characteristics of instructional design models. In R. Reiser & J. Dempsey (Eds.), *Trends and issues in instructional design and technology* (3rd ed.) (pp.8-17). Upper Saddle River, NJ: Merrill-Prentice Hall.

Brickner, D. L. (1995). *The effects of first and second-order barriers to change on the degree and nature of computer usage of mathematics teachers: A case study.* Unpublished doctoral dissertation, Purdue University, West Lafayette.

Caliskan, İ. (2014). A case study about using instructional design models in science education. *Procedia-Social and Behavioral Sciences*, *116*, 394-396. doi: https://doi.org/10.1016/j.sbspro.2014.01.228

Carlson, S., & Gadio, C. T. (2002). Teacher professional development in the use of technology. In W. Haddad & A. Draxler (Eds.), *Technologies for education* (pp.118-132). UNESCO: Paris.

Carr-Chellman, A. A., & Reigeluth, M. C. (2009). Understanding the Instructional Theory. In C. Reigeluth & A. Carr-Chellman (Eds.), *Instructional design theories and models: Building a common knowledge base* (3rd ed.) (pp. 3-26). New York, NY: Routledge.

Carr-Chellman, A. A. (2015). *Instructional design for teachers: Improving classroom practice*. New York, NY: Routledge.

Center for Education Innovations. (2014). *Integration of technology in schools.* Retrieved on September 20, 2016, from http://www.educationinnovations.org/program/integration-technology-schools

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2010). Facilitating preservice teachers' development of technological, pedagogical, and content knowledge (TPACK). *Educational Technology and Society*, *13*(4), 63-73.

Chi, M. T., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive science*, *13*(2), 145-182.

Chinn, M. D., & Fairlie, R. W. (2010). ICT use in the developing world: an analysis of differences in computer and internet penetration. *Review of International Economics*, *18*(1), 153-167.

ChanLin, L. J., Hong, J. C., Horng, J. S., Chang, S. H., & Chu, H. C. (2006). Factors influencing technology integration in teaching: A Taiwanese perspective. *Innovations in Education and Teaching International*, *43*(1), 57-68.

Chen, C. H. (2008). Why do teachers not practice what they believe regarding technology integration? *Journal of Educational Research, 102*(1), 65-75. doi:10.3200 /JOER.102.1.65-75

Chen, O., Woolcott, G., & Sweller, J. (2017). Using cognitive load theory to structure computer-based learning including MOOCs. *Journal of Computer Assisted Learning*, *33*(4), 293-305. doi: 10.1111/jcal.12188.

Chow, A., Hewitt, K., & Downs, H. (2013). Systems thinking and technology integration as catalysts for school change in high needs schools: IMPACT V and the alignment of organizational ends and means. *Educational Research for Social Change*, *2*(1), 7-29.

Christensen, J. (2015). *Teacher perceptions of pedagogical change in 1: 1 laptop classrooms*. Master dissertations, Iowa State University, Ames.

Clark, R. C., Nguyen, F., & Sweller, J. (2011). *Efficiency in learning: Evidence-based guidelines to manage cognitive load*. San Francisco, CA: John Wiley & Sons.

Clements, D., & Sarama, J. (2003). Strip mining for gold: Research and policy in educational technology-A response to ‘Fool’s Gold’. *Educational Technology Review, 11*(1), 7-69.

Coladarci, T. (1992). Teachers’ sense of efficacy and commitment to teaching. *Journal of Experimental Education*, *60*(4), 323-337. doi:10.1080/00220973.1992.9943869

Cohen. J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.).* Hillsdale, NJ: Lawrence Erlbaum Associates.

Collis, B., Mcnaughton, C., Oliver, R., & Winnips, J. C. (1999). Scaffolding: Applications to learning in technology-supported environments. In *Panel presentation, ED-MEDIA'99 World Conference on Educational Multimedia*. AACE.

Creswell, J. W. (2012). *Qualitative inquiry & research design: Choosing among five approaches (4th ed.).* Thousand Oaks, CA: Sage.

Cynthia, L.S. (2015). *The Future of Learning 3: What kind of pedagogies for the 21st century?* Retrieved on October 25, 2017, from http://unesdoc.unesco.org/images/0024/002431/243126e.pdf

Dalal, M., Archambault, L., & Shelton, C. (2017). Professional development for international teachers: examining TPACK and technology integration decision making. *Journal of Research on Technology in Education*, *46*(3-4), 1-17.

Darnawati, W, A., Jamiludin, J., Mursidin, A., & Yuniar, N. (2016). Learning through media development model application: ASSURE. *IOSR Journal of Humanities and Social Science*, *21*(11), 20-25. doi: 10.9790/0837-2111032025

Dawson, V. (2008). Use of information communication technology by early career science teachers in Western Australia. *International Journal of Science Education*, *30*(2), 203-219.

DeJong, T. (2010). Cognitive load theory, educational research, and instructional design: Some food for thought. *Instructional Science, 38*(2), 105-134.

Despres, B. R. (2004). Systemic thinking and education leadership: some considerations. *International Electronic Journal for Leadership in Learning*, *8*(7), 1-9.

Dockstader, J. (1999). Teachers of the 21st century know the what, why, and how of technology integration. *Technological Horizons in Education Journal, 26*(6), 73-74.

DoE. (2016). *A study on the use of information communication technology (ICT) and its sustainability in school education.* Retrieved on July 25, 2017, from http://www.doe.gov.np/assets/uploads/files/578ce1bccdc76f11b30485a70ef3dac1.pdf

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers and Education*, *51*(1), 187-199.

Duhaney, D. C. (2001). Teacher education: preparing teachers to integrate technology. *International Journal of Instructional Media*, *28*(1), 23.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, *47*(4), 47–61.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25-39.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of research on Technology in Education*, *42*(3), 255-284.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education*, *78*(7), 674-681.

Fish, M. (2011). *Technology Integration - What does it really mean?* Retrieved on September 20, 2017, from https://marypkfish.coetail.com/2011/12/15/technology-integration-what-does-it-really-mean/

Fredricks, J. A., & McColskey, W. (2012). The measurement of student engagement: A comparative analysis of various methods and student self-report instruments. In S. Christenson, A. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 763-782). Boston, MA: Springer.

Gilroy, M. (2010). Higher education migrates to YouTube and social networks. *The Education Digest*, *75*(7), 18-22.

Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main barriers and possible enablers of ICTs integration into pre-service teacher education programs. *Journal of Educational Technology and Society*, *12*(1), 193-204.

GoN. (2013). *Information & communications technology (ICT) in education: Master plan 2013-2017*. MOE: Kathmandu. Retrieved on August 15, 2015, from https://ictedupolicy.org/system/files/89_ict_in_education_masterplan_nepal.pdf

GoN. (2016). *ICT in Education in Nepal: Policies and Programs. Paper presented at Workshop for Knowledge Sharing Program on ICT in Education, Seoul. Abstract* retrieved on March 12, 2017, from https://k-learn.adb.org/materials/20161109/ict-education-nepal-policies-and-programs

Gulbahar, Y. (2007). Technology planning: A roadmap to successful technology integration in schools. *Computers and Education*, *49*(4), 943-956. doi: https://doi.org/10.1016/j.compedu.2005.12.002

Gustafson, K. L., & Branch, R. M. (1997). *Survey of instructional development models (4th ed.)*. Syracuse, New York: ERIC Clearinghouse on Information & Technology.

Gustafson, K. L., & Branch, R. M. (2002). What is instructional design? In R. Reiser & J.V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (pp.16-25). Upper Saddle River, NJ: Prentice-Hall Inc.

Haddad, W. D., & Draxler, A. (2002). Technologies for Education: Potential, Parameters, and Prospects. UNESCO, Paris. Retrieved on January 17, 2016, from http://unesdoc.unesco.org/images/0011/001191/119129e.pdf

Hadley, M., & Sheingold, K. (1993). Commonalties and distinctive patterns in teachers' integration of computers. *American Journal of Education*, *101*(3), 261-315.

Hall, I., & Higgins, S. (2005). Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted Learning*, *21*(2), 102-117.

Hare, S., Howard, E., & Pope, M. (2002). Technology integration: Closing the gap between what preservice teachers are taught to do and what they can do. *Journal of Technology and Teacher Education*, *10*(2), 191-203.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, *41*(4), 393-416.

Harris, P., & Sullivan, M. F. (2000). Using technology to create a new paradigm for a learner-centered educational experience. *Technos Bloomington*, *9*(2), 35-36.

Haugland, S. (2005). Selecting or upgrading software and web sites in the classroom. *Early Childhood Education Journal, 32*(5), 329–340.

Heinich, R. (1968). *Application of systems thinking to instruction*. Los Angeles, CA: Education and Training Consultants.

Heinich, R., Molenda, M., Russel, J.D., & Smaldino, S.E. (1996). *Instructional media and technologies for learning (5th ed.).* Hillsdale, NJ: Printice-Hall.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, *55*(3), 223-252.

Horst, T.A. (2016). *The importance of teachers in developing countries.* Retrieved on November 3, 2017, from https://www.facingthefuture.org/blogs/news/126052483-the-importance-of-teachers-in-developing-countries

Hughes, J. E. (2005). The role of teacher knowledge and learning experiences in forming technology-integrated pedagogy. *Journal of Technology and Teacher Education, 13*(2), 377-402.

Hunter, J. (2015). *Technology integration and high possibility classrooms.* New York, NY: Routledge.

Husen, T., Saha, L. J., & Noonan, R. (1978). *Teacher training and student achievement in less developed countries.* World Bank: Washington D.C.

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development*, *58*(2), 137-154.

Jacobsen, M., Clifford, P., & Friesen, S. (2002). Preparing teachers for technology integration: Creating a culture of inquiry in the context of use. *Contemporary Issues in Technology and Teacher Education*, *2*(3), 363-388.

James, N.(2015). *Golden rules for engaging students in learning activities*. Retreived on August 21, 2016, from https://www.edutopia.org/blog/golden-rules-for-engaging-students-nicolas-pino-james

Jang, S.J., & Chen, K.C. (2010). From PCK to TPACK: Developing a transformative model for pre-service science teachers. *Journal of Science Education and Technology, 19*(6), 553–564.

Jang, S.J. (2012). *From PCK to TPACK: Research and development.* New York, NY: Nova Science Publishers, Inc.

Jang, S.J., & Tsai, M.F. (2012). Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect of interactive whiteboards. *Computers and Education, 59*(2), 327-338.

Jhurree, V. (2005). Technology integration in education in developing countries: Guidelines to policy makers. *International Education Journal*, *6*(4), 467-483.

Jones, R. D. (2009). *Student engagement teacher handbook.* Retrieved on September 5, 2016, from https://www.literacytakesflight.com/uploads/7/8/9/3/7893595/strengthen_student_engagement_white_paper.pdf

Johnson, W. (2009). *"ACTIONS" model: Tool for selecting e-technology.* Retrieved on January 16, 2016, from http://www.slideshare.net/WendyJj/actions-model-1332301

Jude, L. T., Kajura, M. A., & Birevu, M. P. (2014). Adoption of the SAMR model to asses ICT pedagogical adoption: A case of Makerere University. *International Journal of e-Education, e-Business, e-Management and e-Learning*, *4*(2), 106-115.

Karmacharya, R. (2015). *Integration of technology in Nepali Classrooms: Lessons learned and future directions.* Retrieved on August 16, 2016, from http://siteresources.worldbank.org/EDUCATION/Resources/BBL-NepalOLE-Karmacharya-4Aug2015.pdf

Karpicke, J. D., & Aue, W. R. (2015). The testing effect is alive and well with complex materials. *Educational Psychology Review*, *27*(2), 317-326.

Kafle, P.A. (2007). *Workforce Development in Nepal: Policies and Practices.* Asian Development Bank Institute: Tokyo, Japan. Retrieved on February 14, 2017, from https://www.adb.org/sites/default/files/publication/159355/adbi-nepalese-education-system.pdf

Kalyanpur, M., & Kirmani, M. H. (2005). Diversity and technology: Classroom implications of the digital divide. *Journal of Special Education Technology*, *20*(4), 9-18.

Kalyuga, S., Chandler, P., & Sweller, J. (2000). Incorporating learner experience into the design of multimedia instruction. *Journal of Educational Psychology, 92*, 126–136.

Keengwe, J., Onchwari, G., & Wachira, P. (2008a). The use of computer tools to support meaningful learning. *Association for the Advancement of Computing in Education, 16*(1), 77-92.

Kennewell, S. (2001). Using affordances and constraints to evaluate the use of ICT in teaching and learning, *Journal of Information Technology for Teacher Education, 10*(1-2), 101-116.

Khan, M., Hossain, S., Hasan, M., & Clement, C. K. (2012). Barriers to the introduction of ICT into education in developing countries: The example of Bangladesh. *International Journal of Instruction, 5*(2), 61-80.

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, *29,* 76-85.

Kim, M. C., & Hannafin, M. J. (2011). Scaffolding problem solving in technology-enhanced learning environments (TELEs): Bridging research and theory with practice. *Computers and Education*, *56*(2), 403-417.

King, K. S., & Frick, T. (1999). Transforming education: Case studies in systems thinking. In *Annual National AERA Meeting, Montreal, Canada*. Retrieved on November 6, 2017, from https://www.indiana.edu/~tedfrick/aera99/transform.html

King, G., & Sen, M. (2013). How social science research can improve teaching. *Political Science and Politics*, *46*(3), 621-629.

Kirschner, P., & Selinger, M. (2003). The state of affairs of teacher education with respect to information and communications technology. *Technology, Pedagogy and Education*, *12*(1), 5-17.doi: 10.1080/14759390300200143

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94-102.

Koehler, M. J., & Mishra, P. (2008). Introducing TPCK. In M.J. Koehler & P. Mishra (Eds.), *Handbook of technological pedagogical content knowledge for educators* (pp 3-29). New York, NY: Routledge.

Koohang, A. A. (1989). A study of attitudes toward computers: Anxiety, confidence, liking, and perception of usefulness. *Journal of Research on Computing in Education, 22*(2), 137-150.

Kopcha, T. J., Ottenbreit-Leftwich, A., Jung, J., & Baser, D. (2014). Examining the TPACK framework through the convergent and discriminant validity of two measures. *Computers and Education, 78,* 87-96.

Kozma, R. B. (2002). *ICT and educational reform in developed and developing countries*. CA: SRI International.

Kulik, J. A. (2003). *Effects of using instructional technology in elementary and secondary schools: What controlled evaluation studies say*? Arlington, VA: SRI International.

Lannon-Kim, C. (1991). Revitalizing the schools: a systems thinking approach. *The Systems Thinker, 2*(5), 1-4.

Lawton, J., & Gerschner, V. T. (1982). A review of the literature on attitudes towards computers and computerized instruction. *Journal of Research and Development in Education, 16*(1), 50-55.

Lee, J. (2014). "Technology Integration Challenges for Teachers in Nepal" *Paper presented at the annual meeting of the Comparative and International Education Society Annual Conference, Sheraton Centre Toronto, Toronto, Ontario, Canada.*

Lee, J. C. Y., & Sparks, P. (2014). Three hurdles to technology integration: A case study of technology integration in Bungamati. *Journal of Nepal English Language Teachers' Association*, *18*(1-2), 105-114. doi: http://dx.doi.org/10.3126/nelta.v18i1-2.10334

Lee, C. J., & Kim, C. (2014a). An implementation study of a TPACK-based instructional design model in a technology integration course. *Educational Technology Research and Development*, *62*(4), 437-460.

Lee, C. J., & Kim, C. (2014b). The second prototype of the development of a technological pedagogical content knowledge based instructional design model: an implementation study in a technology integration course. *Contemporary Issues in Technology and Teacher Education*, *14*(3), 297-326.

Lim, C. P., Cock, K., Lock, G., & Brook, C. (2009). *Innovative practices in pre-service teacher education*. Rotterdam: Sense Publication.

Lim, C.P. & Chai, C.S. (2008). Rethinking classroom – oriented instructional development models to mediate instructional planning in technology enhanced environments. *Teaching and Teacher Education 24*(8), 2002-2013.

Lim, C. P. & Pannen, P. (2012). Building the capacity of Indonesian education universities for ICT in pre-service teacher education: A case study of a strategic planning exercise. *Australasian Journal of Educational Technology, 28*(6), 1061-1067.

Linderoth, J. (2013). *Open letter to Dr. Ruben Puentedura* [Blog post]. Retrieved on December 15, 2017, from http://spelvetenskap.blogspot.com/2013/10/openletter-to-dr-ruben-puentedura.html.

Lopez, O.S. (2010). The digital learning classroom: Improving english language learners' academic success in mathematics and reading using interactive whiteboard technology. *Computers and Education, 54*(4), 901-915.

Mager, R. F. (1984). *Measuring instructional results: Got a match*. Belmont, CA: Pitman Publishing.

Markauskaite, L. (2006). Gender issues in preservice teachers' training: ICT literacy and online learning. *Australasian Journal of Educational Technology*, *22*(1), 1-20.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist*, *38*(1), 43-52.

Maddin, E. (2012). *Developing Technology Leadership in PK-12 Schools: A Systems Thinking Approach.* Proceedings of Global TIME – Online Conference on Technology, Innovation, Media & Education (pp. 62-65). Association for the Advancement of Computing in Education (AACE). Retrieved on November 12, 2017, from https://learntechlib.org/p/39397/

McKenney, S., & Voogt, J. (2012). Teacher design of technology for emergent literacy: An explorative feasibility study. *Australasian Journal of Early Childhood*, *37*(1), 4–12.

Mecoli, S. (2013). The influence of the pedagogical content knowledge theoretical framework on research on preservice teacher education. *Journal of Education*, *193*(3), 21-27.

Melissa, J.I., & Heather, M, H. (2013). Redefining technology in libraries and schools: AASL best apps, best websites, and the SAMR model. *Teacher Librarian*, *42*(2), 16-19.

Miller, C., Hokanson, B., Doering, A., & Brandt, T. (2010). Role-based design: Design experiences. *Educational Technology*, *50*(6), 3-10.

Mishne, J. (2012). *An investigation of the relationships between technology use and teachers' self-efficacy, knowledge and experience*. Unpublished doctoral dissertation, Pepperdine University, CA.

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record*, *108*(6), 1017-1054.

Mishra, P., & Koehler, M. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60-70.

Mishra, P., Koehler, M. J., & Kereluik, K. (2009). The song remains the same: Looking back to the future of educational technology. *Tech Trends, 53*(5), 48–53.

MoE. (2013). *ICT Master Plan (20013-2017) on Education.* Ministry of Education, Singh Durbar, Nepal.

Moore, K. J., & Knowlton, D. S. (2006). Students as library detectives and books as clues: An application of ISD in K-12 schools. *Tech Trends*, *50*(3), 59-63.

Morrison, G. R., Ross, S. M., Kemp, J. E., & Kalman, H. (2010). *Designing effective instruction.* Hoboken, NJ: John Wiley & Sons.

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education*, *9*(3), 319-342.

Mustafina, A. (2016). Teachers' attitudes toward technology integration in a Kazakhstani secondary school. *International Journal of Research in Education and Science*, *2*(2), 322-332.

Nepal Campaign for Education Nepal (2017). *Pre-service Teacher Education in Nepal: A Qualitative Case Study.* Retrieved on January 18, 2017, from http://ncenepal.org.np/wp-content/uploads/2017/11/PST-report-final-copy.pdf

Nguyen, N. C., Bosch, O. J., & Maani, K. E. (2011). Creating 'learning laboratories' for sustainable development in biospheres: a systems thinking approach. *Systems Research and Behavioral Science*, *28*(1), 51-62.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, *21*(5), 509-523.

Norris, C., Sullivan, T., & Poirot, J. (2003). No access, no use, no impact: Snapshot surveys of educational technology in K-12. *Journal of Research on Technology in Education*, *36*(1), 15-27.

NPC. (2007). 10th Plan, National Planning Commission, Singh Durbar, Nepal.

Nuangchalerm, P., & Prachagool, V. (2010). Influences of teacher preparation program on preservice science teachers' beliefs. *International Education Studies*, *3*(1), 87-91

Okojie, M. C., Olinzock, A. A., & Okojie-Boulder, T. C. (2006). The pedagogy of technology integration. *Journal of Technology Studies*, *32*(2), 66-71.

Oosthuizen, A. (2016). *Characteristics of 21st century learners and the challenges they cause teachers.* Retrieved on November 20, 2016, from file:///C:/Users %20November%202016_engels.pdf

Padmavathi, M. (2016). Preparing teachers for technology based teaching learning using TPACK. *I-Manager's Journal on School Educational Technology*, *12*(3), 1-9.

Parette, H., & Blum, C. (2013). *Instructional technology in early childhood: Teaching in the digital age*. Baltimore, MD: Brookes.

Park, J. (2011). *ICT in education in Asia-pacific*. Retrieved on November 10, 2017, from http://workspace.unpan.org/sites/internet/Documents/UNPAN93450.pdf

Parks, A., & Pisapia, J. (1994). *Developing exemplary technology-using teachers*. Retrieved on December 11, 2017, from https://files.eric.ed.gov/fulltext/ED411360.pdf

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist*, *38*(1), 1-4.

Pelgrum, W. & Anderson, R. (1999). *ICT and the emerging paradigm for lifelong learning: An IEA educational assessment of infrastructure, goals, and practices in twenty-sex countries.* Retrieved on March 20, 2017 from https://www.iea.nl/fileadmin/user_upload/Publications/Electronic_versions/SITES-M1_ICT_Emerging_Paradigm.pdf

Picciano, A.G. (2011). *Educational leadership and planning for technology (5th ed.).* New York, NY: Pearson.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education*, *33*(4), 413-430.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, *82*(1), 33-40.

Piskurich, M. G., (2006). What Is This Instructional Design Stuff Anyway? In G.M. Piskurich (Ed.), *Rapid instructional design: Learning ID fast and right (2nd ed.),* (pp 2-13). San Francisco, CA: John Wiley & Sons.

Pittman, T., & Gaines, T. (2015). Technology integration in third, fourth and fifth grade classrooms in a Florida school district. *Educational Technology Research and Development*, *63*(4), 539-554.

Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and Teacher Education*, *26*(4), 863-870.

Prensky, M. (2008). *The 21st-Century Digital Learner: How tech-obsessed iKids would improve our schools*. Retrieved on July 17, 2016, from https://www.edutopia.org/ikid-digital-learner-technology-2008

Prince, M., & Felder, R. (2007). The many faces of inductive teaching and learning. *Journal of College Science Teaching*, *36*(5), 14-20.

Puentedura, R. R. (2006). *The SAMR model: Transformation, technology, and education.* Retrieved on November 17, 2017, from http://hippasus.com/resources/tte

Ramorola, M. Z. (2013). Challenge of effective technology integration into teaching and learning. *Africa Education Review*, *10*(4), 654-670.

Rana, K. B. (2017). *Use of Educational Technologies in Teaching and Learning Activities: Strategies and Challenges-A Nepalese case* (master's thesis). Retrieved on September 25, 2017 from https://www.duo.uio.no/bitstream/handle/10852/60803/HEM4390.pdf?sequence=1&isAllowed=y

Renkl, A. (2005). The worked-out examples principle in multimedia learning. In R. E. Mayer (Ed.), *Handbook of multimedia learning* (pp. 229-246). Cambridge: Cambridge University Press.

Richard, V. E. (2009). A Guide to integrating COTS Games into Your Classroom. In V. E. Richard (Ed.), *Handbook of research on effective electronic gaming in education* (pp. 179-199). doi: 10.4018/978-1-59904-808-6.ch011

Richey, R.C., Klein, J., & Nelson, W. (2004). Developmental research: Studies of instructional design and development. In D. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp.1099-1130). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Richey, R. C., & Klein, J. D. (2005). Developmental research methods: Creating knowledge from instructional design and development practice. *Journal of Computing in Higher Education*, *16*(2), 23-38.

Richey, R. C., & Klein, J. D. (2007). *Design and development research: Methods, strategies, and issues*. Mahwah, NJ: Lawrence Erlbaum Associates.

Rijal, M. (2013). *Let's integrate technology with teaching.* Retrieved on August 15, 2015, from https://neltachoutari.wordpress.com/2013/09/01/lets-integrate-technology-with-teaching/

Rodriguez, V. (2013). The potential of systems thinking in teacher reform as theorized for the teaching brain framework. *Mind, Brain, and Education*, *7*(2), 77-85.

Rubenstein-Montano, B., Liebowitz, J., Buchwalter, J., McCaw, D., Newman, B., & Rebeck, K. (2001). A systems thinking framework for knowledge management. *Decision Support Systems*, *31*(1), 5-16.

Salden, R.J.C.M, Aleven, V., Schwonke, R., & Renkl, A. (2008). The expertise reversal effect and worked examples in tutored problem solving. *Instructional Science, 38*(3), 289-307

Saravanan, T., & Nagadeeps, N. (2017). Impact of information communication and technology integration on stress & cognitive load. *International Journal of Pure and Applied Mathematics, 116*(10), 349-359.

Schmidt, D. A., Baran, E., Thompson A. D., Koehler, M. J., Mishra, P. & Shin, T. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education, 42*(2), 123-149.

Sezer, B., Karaoglan Yilmaz, F. G., & Yilmaz, R. (2013). Integrating technology into classroom: The learner-centered instructional design. *International Journal on New Trends in Education and Their Implications*, *4*(4), 134-144.

Shaffer, C. (1989). A comparison of inductive and deductive approaches to teaching foreign languages. *The Modern Language Journal*, *73*(4), 395-403.

Shirvani, H. (2014). Pre-service teachers' attitudes toward using technology in schools. *Journal of Literacy and Technology*, *15*(1), 33-53.

Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. E*ducational Researcher, 15*(2), 4-14.

Shukla, V. (2012). Teacher education in the globalized world. *International Journal of Multidisciplinary Research 2*(7), 197-205

Smith, K. A., Sheppard, S. D., Johnson, D. W., & Johnson, R. T. (2005). Pedagogies of engagement: Classroom-based practices. *Journal of Engineering Education*, *94*(1), 87-101.

Smith, H.J., Higgins, S., Wall, K. & Miller, J. (2005). Interactive whiteboards: Boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning, 21*(2), 91-101.

Smith, P.L., & Ragan, T.J. (2005). *Instructional design* (3rd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Smaldino, S. E., Lowther, D. L., & Russell, J. D. (2008). *Instructional technology and media for learning* (9th ed.). Upper Saddle River, NJ: Pearson.

Stuart, C., & Thurlow, D. (2000). Making it their own: Preservice teachers' experiences, beliefs, and classroom practices. *Journal of Teacher Education*, *51*(2), 113-121.

Summerville, J., & Reid-Griffin, A. (2008). Technology integration and instructional design. *Tech Trends, 52*(5), 45-51.

Surry, D. W., & Farquhar, J. D. (1997). Diffusion theory and instructional technology. *Journal of Instructional Science and Technology, 2*(1), 24-36.

Taylor, M., Harlow, A. & Forret, M. (2010). Using a computer programming environment and an interactive whiteboard to investigate some mathematical thinking. *Procedia Social and Behavioral Science, 8*, 561-570.

Tabbers, H. K., Martens, R. L., & van Merriënboer, J. J. (2000). *Multimedia instructions and cognitive load theory: Split-attention and modality effects*. Paper presented at the Association for Educational Communications and Technology 2000, Long Beach, CA. Abstract retrieved on September 27, 2016, from https://www.ou.nl/Docs/Expertise/OTEC/Publicaties/huib%20tabbers/AECT2000%20Huib%20Tabbers.pdf

Tearle, P., & Golder, G. (2008). The use of ICT in the teaching and learning of physical education in compulsory education: How do we prepare the workforce of the future? *European Journal of Teacher Education*, *31*(1), 55-72.

Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. *Computers and Education*, *52*(2), 302-312. doi: https://doi.org/10.1016/j.compedu.2008.08.006

Tsai, C. C., & Chai, C. S. (2012). The" third"-order barrier for technology-integration instruction: Implications for teacher education. *Australasian Journal of Educational Technology*, *28*(6), 1057-1060.

Tondeur, J., Pareja Roblin, N., van Braak, J., Voogt, J., & Prestridge, S. (2017). Preparing beginning teachers for technology integration in education: ready for take-off? *Technology, Pedagogy and Education*, *26*(2), 157-177.

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers and Education*, *59*(1), 134-144.

TU. (2017). *Faculty of education.* Retrieved on November 11, 2017, from http://tribhuvan-university.edu.np/faculties/faculty-of-education/

UN. (2017). *Quality education: Why it matters*. Retrieved on October 31, 2017, from http://www.un.org/sustainabledevelopment/wp-content/uploads/2017/02/ENGLISH_Why_it_Matters_Goal_4_QualityEducation.pdf

UNESCO. (2008). *ICT competency standards for teachers: Competency standards modules.* Retrieved on March 22, 2016, from http://unesdoc.unesco.org/images/0015/001562/156210E.pdf

U.S. Department of Education. (2002). *Technology in schools: Suggestions, tools, and guidelines for assessing technology in elementary and secondary education*. Retrieved on April 14, 2016, from http://nces.ed.gov/pubs2003/tech_schools/index.asp

Van Gog, T., Kester, L., & Paas, F. (2011). Effects of worked examples, example-problem, and problem-example pairs on novices' learning. *Contemporary Educational Psychology*, *36*(3), 212-218.

Vatanartiran, S., & Karadeniz, S. (2015). A needs analysis for technology integration plan: Challenges and needs of teachers. *Contemporary Educational Technology*, *6*(3), 206-220.

van Merrienboer, J.J.G. (1997). *Training complex cognitive skills: A four-component instructional design model for technical training*. Englewood Cliffs, New Jersey: Educational Technology Publications.

van Merrienboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review*, *17*(2), 147–177.

van Gog, T., & Rummel, N. (2010). Example-based learning: Integrating cognitive and social-cognitive research perspectives. *Educational Psychology Review, 22*(1), 155-174.

Wagle, M.P. (2013). *Integrate ICT into education system.* Retrieved on September 5, 2016, from https://thehimalayantimes.com/kathmandu/integrate-ict-education-system/

Wagle, M.P., & Jha, A. (2013). *Country report: Nepal - Education in general and ICT in particular*. Retrieved on December 18, 2015, from http://uis.unesco.org/sites/default/files/documents/information-communication-technologies-education-asia-ict-integration-e-readiness-schools-2014-en_0.pdf

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education*, *36*(3), 231-250. doi: http://dx.doi.org/10.1080/15391523.2004.10782414

Ward, P., & Zhou, H. (2006). Impact of information technology integration and lean/just-in-time practices on lead-time performance. *Decision Sciences*, *37*(2), 177-203. doi: 10.1111/j.1540-5915.2006.00121.x

Webb, M., & Cox, M. (2004). A review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education*, *13*(3), 235-286.

Whitaker, F. (2017). *Sustainable Development Goal 9: Investing in ICT access and quality education to promote lasting*. Retrieved on October 31, 2017, from http://www.un.org/sustainabledevelopment/blog/2017/06/sustainable-development-goal-9-investing-in-ict-access-and-quality-education-to-promote-lasting-peace/

Willis, E. M., & Tucker, G. R. (2001). Using constructionism to teach constructivism: Modeling hands-on technology integration in a preservice teacher technology course. *Journal of Computing in Teacher Education*, *17*(2), 4-7.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, *17*(2), 89-100.

World Bank. (2010). *ICT for education in India and South Asia.* Retrieved on July 24, 2016, from http://www.infodev.org/articles/ict4e-india-and-south-asia-extended-summary-0

World Bank. (2012). ICT for greater development impact: World Bank group strategy for ICT, 2012-2015. Retrieved on June 17, 2016, from https://openknowledge.worldbank.org/handle/10986/27411 License: CC BY 3.0 IGO."

World Bank. (2017). *Technology and innovation in education.* Retrieved on November 9, 2017, from http://www.worldbank.org/en/topic/edutech#2

Wozney, L., Venkatesh, V., & Abrami, P. (2006). Implementing computer technologies: Teachers' perceptions and practices. *Journal of Technology and Teacher Education, 14*(1), 173-207.

Wright, V. H., Wilson, E. K., Gordon, W., & Stallworth, J. B. (2002). Master technology teacher: A partnership between preservice and in-service teachers and teacher educators. *Contemporary Issues in Technology and Teacher Education*, *2*(3), 353-362.

Yelland, N. (2005). Curriculum, pedagogies and practice with ICT in the information age. In N. Yelland (Ed.), *Critical Issues in Early Childhood Education* (pp. 224–242). UK: Open University Press.

# Appendices

# **Appendix 1**: Research Ethics Committee

Notification of Investigation
Results

Date: 7/8/2016

To (Applicant): Professor JUNG, Insung
From: President, International Christian University

Document No.: 2016-9
Name of Research Project: Developing and Validating TPACK-integrated Instructional Design Model for Technology Integrated Preservice Course
Individual Responsible for Research: BAJRACHARYA Jiwak Raj

I herewith notify you of the following results of the Research Ethics Committee's investigation of the above named research project.

| |
|---|
| 1. Decision:<br>■ Approved<br>☐ Conditional approval<br>☐ Change recommended<br>☐ Rejected<br>☐ Not applicable |
| 2. Reason:<br><br>N/A |
| 3. Remarks:<br>"Approval" with the following remarks:<br>1) The final place for storage of research data and consent forms should be your advisor's office. The advisor should decide the storage period such as 5 years/10years, manage and discard them under strict control. |

※ If changes are recommended, investigation request must be resubmitted.

Signatur

## **Appendix 2**: Research Application to Educational Institutions

To,
The Campus Chief
__________Campus
Kathmandu, Nepal

Date: 7 December 2016

**REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN CAMPUS**

Dear Sir,

My name is Jiwak Raj Bajracharya, and I am a Doctoral candidate at the International Christian University (ICU) in Tokyo. The research I wish to conduct for my PhD Thesis titled "Developing and Validating TPACK-integrated Instructional Design Model for Technology Integration". The main purpose of this study is to develop and validate model, which will guide Faculty of Education to train pre service teacher for effective technology integration with the consideration of content that need to be taught and pedagogical strategies. This PhD project will be conducted under the supervision of Prof. Dr. Jung Insung (ICU, Tokyo).

I am hereby seeking your consent to a conduct final research with B.Ed. students from December 2016 to February 2017.

Once, I got an official permission, I will provide you with a copy of my proposal which includes copies of the measure and consent and assent forms to be used in the research process, as well as a copy of the approval letter which I received from the ICU Research Ethics Committee (Human).

Upon completion of the study, I undertake to provide you with a bound copy of the full research report. If you require any further information, please do not hesitate to contact me on jiwakps@gmail.com .

Thank you for your time and consideration in this matter.

Yours sincerely,

[Jiwak Raj Bajracharya]

PhD Candidate

International Christian University

**Appendix 3**: Research Participants' Consent Form

Developing and Validating a TPACK-integrated Instructional Design Model for a Preservice Teachers' Program in a Developing Country

International Christian University, Tokyo

**Purpose of Research**

The main purpose of the research is to develop and validate a technology integration model for preservice teachers' instructors in a preservice teachers' program

**Procedure**

The preservice teachers' instructors will deliver their classroom instructions based on a TPACK-integrated ID model to train preservice teachers.

**Duration of Participation**

From 8 December 2016 till 2 February 2017

**Benefits to the Individual**

The participants (teacher educators and preservice teachers) will receive additional teaching and learning strategies using different technologies based on the content and different teaching approach.

**Risk to the Individual**

There will not be any risk due to the intervention during the research period.

**Confidentiality**

The researcher will ensure that the data collected from participant are stored with care and secured in order to protect the privacy and confidentiality of the participant. All data (inclusive of text, audio, photo, video, etc.) collected from the participants will be kept in the hardcopy and digital format and will strictly be used for reporting the findings of this research.

**Voluntary Nature of Participation**

I do not have to participate in this research project. If I agree to participate I can withdraw my participation at any time without penalty.

**Human Subject Statement**

If I have any question about this research project, I can contact Mr. Jiwak Raj Bajracharya at International Christian University, Tokyo. The email address is jiwakps@gmail.com

I HAVE HAD THE OPPORTUNITY TO READ THIS CONSENT FORM, ASK QUESTIONS ABOUT THE RESEARCH PROJECT AND AM PREPARED TO PARTICIPATE IN THIS PROJECT.

Participant's Signature                Date

Participant's Name

Researcher's Signature                Date

**Appendix 4**: Observation Sheet

**Classroom Observation Protocol for Content-Pedagogy-Technology Integrated Classroom**

Date:

Instructor:

Observer:

***Key advantages of ID process for technology integration***

| |
|---|
| Tool and applications use by the TEP instructors and preservice teachers |

| |
|---|
| Pedagogical strategies to engage preservice teachers |

| |
|---|
| Integration of content, pedagogy, and technology |

## **Appendix 5**: Interview Protocol for Preservice Teacher Program instructors

***Week 1***

1) How do you define good teaching?
2) Describe your teaching style.
3) How would you characterize your level of technological knowledge?
4) How would you characterize your level of pedagogical knowledge?
5) Tell about, how you would use technology in your day-to-day job?
6) What technology applications have you utilized in the classroom?

***Week 2***

1) What changes have you brought with an implementation of a package of a model?
2) What are the factors that motivates you to adopt the model in future?
3) What are the factors that demotivate you to adopt the model in future?
4) Will you feel an extra load if you have to follow a package of a model in the future?
5) Any additional thing that you would like to add regarding the model?

***Week 3***

1) Please share your experiences about using the model in the classroom?
2) Are you able to follow the every phases?
3) Did you found that, worked examples helps you?
4) What changes have you brought to the teaching with the implementation of a model?
5) Do you think that your instructions based on the model will produce a technology competent teacher?
6) Any additional thing that you would like to add regarding the model?

## **Appendix 6**: Engagement Checklists

**Engagement Checklists**

**-----------------------------------------------------------------------------------------**

**PART I: Observations**

*(Engagement Checklist)*

***Positive Body Language***

| Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|
| | | | | |

***Consistent Focus***

| Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|
| | | | | |

***Verbal Participation***

| Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|
| | | | | |

***Student Confidence***

| Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|
| | | | | |

***Fun and Excitement***

| Very High | High | Medium | Low | Very Low |
|---|---|---|---|---|
| | | | | |

## **Appendix 7**: Perceived Learning Outcomes

For the following items, please circle the answer that best shows your opinion

| *Strongly Disagree* | *Disagree* | *Undecided* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

**Technology Knowledge**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | I have technical skills that need to use technology | 1 | 2 | 3 | 4 | 5 |
| 2 | I can use picture editing program (paint) | 1 | 2 | 3 | 4 | 5 |
| 3 | I can use google drive | 1 | 2 | 3 | 4 | 5 |
| 4 | I can use printer | 1 | 2 | 3 | 4 | 5 |
| 5 | I know how to solve my technical problems | 1 | 2 | 3 | 4 | 5 |
| 6 | I can use word processor program | 1 | 2 | 3 | 4 | 5 |
| 7 | I can use presentation program | 1 | 2 | 3 | 4 | 5 |
| 8 | I can use spreadsheet program | 1 | 2 | 3 | 4 | 5 |
| 9 | I can use projector | 1 | 2 | 3 | 4 | 5 |
| 10 | I have had sufficient opportunities to work with different technologies | 1 | 2 | 3 | 4 | 5 |
| 11 | I keep up with important new technologies | 1 | 2 | 3 | 4 | 5 |
| 12 | I can use Facebook | 1 | 2 | 3 | 4 | 5 |
| 13 | I want to use Facebook for education | 1 | 2 | 3 | 4 | 5 |
| 14 | I can learn technology easily | 1 | 2 | 3 | 4 | 5 |
| 15 | I frequently play around with the technology | 1 | 2 | 3 | 4 | 5 |
| 16 | I can save into digital medium (USB drive, CD etc.) | 1 | 2 | 3 | 4 | 5 |
| 17 | I can use drop box | 1 | 2 | 3 | 4 | 5 |
| 18 | I can use digital camera | 1 | 2 | 3 | 4 | 5 |

**Content Knowledge**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | I know about key subjects in my area | 1 | 2 | 3 | 4 | 5 |
| 2 | I can develop class activities | 1 | 2 | 3 | 4 | 5 |
| 3 | I can attain workshops in my content area | 1 | 2 | 3 | 4 | 5 |
| 4 | I can follow recent news in my content area | 1 | 2 | 3 | 4 | 5 |
| 5 | I can attain conferences in my content area | 1 | 2 | 3 | 4 | 5 |
| 6 | I can develop class projects | 1 | 2 | 3 | 4 | 5 |
| 7 | I can recognize leaders in my content area | 1 | 2 | 3 | 4 | 5 |
| 8 | I can follow up-to-date resources using academic journal in my content area | 1 | 2 | 3 | 4 | 5 |

**Pedagogical Knowledge**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | I can use a wide range of teaching approaches in a classroom teaching | 1 | 2 | 3 | 4 | 5 |
| 2 | I am familiar with common student understands and misconceptions | 1 | 2 | 3 | 4 | 5 |
| 3 | I can adapt my teaching based upon what students currently understand or not | 1 | 2 | 3 | 4 | 5 |
| 4 | I know how to organize ad maintain classroom management | 1 | 2 | 3 | 4 | 5 |
| 5 | I can assess student learning in multiple ways | 1 | 2 | 3 | 4 | 5 |
| 6 | I know how to assess student performance class-room | 1 | 2 | 3 | 4 | 5 |
| 7 | I can adapt my teaching style to different learners | 1 | 2 | 3 | 4 | 5 |

**Any Comments**

# **Appendix 8**: Paper-based Test

## Exam Questions

## (General English: Case I)

Name:

ID No:

***Fill in the blanks: (5×4= 20)***

Change the following sentences using the process of nominalization

1. As civilization has __________ the landscape has been changed in a number of ways. (expand)
2. The degree of flooding is determined by how much water __________in an area, as well as the nature of land surface. (accumulate)
3. The man __________a lot which made him happy. (achieve)
4. We will see how concrete and other things that humans __________can affect flooding. (construct)
5. The world is __________ which has united the people. (global)

***Write an essay: (1×20= 20)***

1. Wildlife of Nepal

   OR

   Tourism development in your village

***Story telling: (1×10 =10)***

Topics will be given at the time of presentation

*(1 minute per student)*

## Exam Questions

## (Academic Writing: Case II)

Name:

ID No:

***Circle the appropriate word with reasons: (2×5= 10)***

1. Reality Principle

(a) Sky is Blue (b) Moon might be smaller than Earth (c) Blood is Red (d) Males were Aggressive

*Reason:*

______________________________________________________________________________

______________________________________________________________________________

___________________________________________________________________________

2. Thesis Statement

(a) It could be debatable (b) It should be debatable (c) It should be Fact (d) It should be debatable and fact

*Reason:*

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

***Define in short: (5×2= 10)***

| |
|---|
| Thesis statement (write with 2 examples): |

| |
|---|
| Validation of thesis statement (write with 4 examples): |

***List the part of Thesis: (1×10)***

| |
|---|
| |

***Describe about picture: (1×20)***

Work in Group
(3 min= Think and prepare, 3 min = Presentation)

## Exam Questions

**(Subject: E-learning: Case III)**

Name:

ID No:

***Attempt all the questions***

*A. <u>Written Exam:</u>* ***(10×4=40)***

1. What are the difference types of e-Learning Methods? Describe it.
2. What is CSS? Explain.
3. What are the different types of errors in the PHP?
4. What is a Java Script? Create three mouse control events to control the client side form.

*B. <u>Demonstration</u>* ***(10×1=10)***

1. How can we create a database using PHP and My SQL? Demonstrate with suitable example

## **Appendix 9**: Observations - Teaching Practice

Date:

Preservice Teacher:

Observer:

| |
|---|
| Technological tools used by preservice teachers |

| |
|---|
| Integration of content, pedagogy, and technology |

**Appendix 10**: Questionnaires

## Technology Integration Survey

The purpose of this survey is to determine how you feel about technology integration into classroom teaching. For each statement below. Indicate the strength of your agreement or disagreement by circling on the five scales.

**PART I: Preservice Teachers' Demographic Information**

| | |
|---|---|
| Gender | Male / Female / Others |
| Age | |
| Religion | |
| Family name | |
| Birth place | |
| Teaching experience | YES ( weeks) NO |
| Have you attend computer training? | YES NO |
| If Yes, which course? | |
| Do you have Desktop PC at home? | YES NO |
| Do you have own Laptop? | YES NO |
| Do you have internet/Wi-Fi connection at home? | YES NO |

## PART II: Preservice Teachers' Self-efficacy toward technology integration

For the following items, please circle the answer that best shows your opinion

| *Strongly Disagree* | *Disagree* | *Undecided* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

| **I feel confident that……** | | | | | | |
|---|---|---|---|---|---|---|
| 1 | I understand technologies well enough to maximize them in my classroom | 1 | 2 | 3 | 4 | 5 |
| 2 | I have the skills necessary to use technologies for instruction | 1 | 2 | 3 | 4 | 5 |
| 3 | I can teach relevant subject content with appropriate use of technology | 1 | 2 | 3 | 4 | 5 |
| 4 | I can evaluate software for teaching and learning | 1 | 2 | 3 | 4 | 5 |
| 5 | I can use correct technological terminology when directing students' | 1 | 2 | 3 | 4 | 5 |
| 6 | I can help students when they have difficult with technology | 1 | 2 | 3 | 4 | 5 |
| 7 | I can effectively monitor students' computer use for project development | 1 | 2 | 3 | 4 | 5 |
| 8 | I can motivate my students to participate in technology-based projects. | 1 | 2 | 3 | 4 | 5 |
| 9 | I can mentor students in appropriate uses of technology | 1 | 2 | 3 | 4 | 5 |
| 10 | I can consistently use educational technology in effective ways | 1 | 2 | 3 | 4 | 5 |
| 11 | I can provide individual feedback to students using technology use | 1 | 2 | 3 | 4 | 5 |
| 12 | I can regular incorporate technology into my lessons to student learning | 1 | 2 | 3 | 4 | 5 |
| 13 | About selecting appropriate technology for instruction based on curriculum standards | 1 | 2 | 3 | 4 | 5 |
| 14 | About assigning and grading technology-based-projects | 1 | 2 | 3 | 4 | 5 |
| 15 | About keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning | 1 | 2 | | 4 | 5 |
| 16 | About using technology resources (such as: spreadsheets, electronic portfolios, etc.) to collect and analyze data from students tests and products to improve instructional practices. | 1 | 2 | 3 | 4 | 5 |
| 17 | I will be comfortable using technology in teaching | 1 | 2 | 3 | 4 | 5 |
| 18 | As time goes by, my ability to address my students technology needs will continue to improve. | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 19 | I can develop creative ways to cope with system constrains (such as budget cuts on technology facilities) and continue to teach effectively with technology | 1 | 2 | 3 | 4 | 5 |
| 20 | I can carry out technology-based projects even when I am opposed by skeptical colleagues | 1 | 2 | 3 | 4 | 5 |

**<u>PART III: Preservice Teachers' Attitude toward technology</u>**

| **When using technology……….** | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Student create products that show higher level of learning | 1 | 2 | 3 | 4 | 5 |
| 2 | There are more discipline problems | 1 | 2 | 3 | 4 | 5 |
| 3 | Students are more motivated | 1 | 2 | 3 | 4 | 5 |
| 4 | Student go to appropriate sites | 1 | 2 | 3 | 4 | 5 |
| 5 | There is more student collaboration | 1 | 2 | 3 | 4 | 5 |
| 6 | Plagiarism becomes more bigger problem | 1 | 2 | 3 | 4 | 5 |
| 7 | The abundance of unreliable sources is disturbing | 1 | 2 | 3 | 4 | 5 |
| **I believe……….** | | | | | | |
| 8 | Most technology would do little to improve my teaching | 1 | 2 | 3 | 4 | 5 |
| 9 | Technology has changed the way that I teach | 1 | 2 | 3 | 4 | 5 |
| 10 | Students are more knowledgeable than I'm when it comes to technology | 1 | 2 | 3 | 4 | 5 |
| 11 | School systems expect us to learn new technologies without formal training | 1 | 2 | 3 | 4 | 5 |
| 12 | There is too much technological change coming too fast without enough support | 1 | 2 | 3 | 4 | 5 |
| 13 | Technology has left many teachers behind | 1 | 2 | 3 | 4 | 5 |
| 14 | Technology is a good tool for collaboration with other teachers when building unit plans | 1 | 2 | 3 | 4 | 5 |
| 15 | I learn new technologies best by figuring them out myself | 1 | 2 | 3 | 4 | 5 |
| 16 | Technology is useful in managing student data such as attendance and grades | 1 | 2 | 3 | 4 | 5 |
| 17 | Technology is unreliable | 1 | 2 | 3 | 4 | 5 |
| 18 | I perceive computers as pedagogical tools | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 19 | I generally have positive attitude towards using computer technology in teaching | 1 | 2 | 3 | 4 | 5 |
| 20 | I like using computers for teaching purposes | 1 | 2 | 3 | 4 | 5 |
| 21 | I like searching the internet for teaching resources | 1 | 2 | 3 | 4 | 5 |
| 22 | Technology can be good supplement to support teaching and learning | 1 | 2 | 3 | 4 | 5 |
| 23 | I believe I can take risks in teaching with technology | 1 | 2 | 3 | 4 | 5 |
| 24 | I am not the type to do well with computerized teaching tools. | 1 | 2 | 3 | 4 | 5 |

# **Appendix 11**: Worked Examples for the Main Study

## i) To utilize key phases and key components of a TPACK-integrated ID model for the main study

**Stage 1: Analyze**

To identify the general characteristics of the preservice teachers and their level of prior knowledge.

A. *General characteristics of preservice teachers*

Gender

| | | | | | |
|---|---|---|---|---|---|
| Male | | Female | | Other | |

Age group

| | | | | | |
|---|---|---|---|---|---|
| 10’s | | 20’s | | 30’s | |

English language proficiency

*(Circle the most appropriate one)*

| Low | Low-medium | Medium | High-medium | High |
|---|---|---|---|---|
| | | | | |

Ownership of technological tools

| Laptop | Desktop | Recorder | Mobile | Tablet | Others |
|---|---|---|---|---|---|
| | | | | | |

Ownership of technological applications

| Word | Excel | PowerPoint | Paint | Moviemaker | Others |
|---|---|---|---|---|---|
| | | | | | |

B. *Prior knowledge of preservice teachers*

Teaching practice experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

Technological experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

Social media experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

Content experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

**Stage 2:Explore**

To investigate the possibility of available contents, technologies, and human resources.

A. *Content resources*

Availability of references (books, magazines, journals etc.)

Availability of electronic databases

B. *Technology resources*

Availability of technological tools and applications (Screen, Skype, Word etc.)

Availability of alternatives (of power) during power outages

Availability of computers

Availability of over-head projectors

Availability of various technological tools (scanner, printer etc.)

Availability of internet/Wi-Fi

Yes ☐

No ☐

C. *Human resources*

Availability of class-support on demand

Yes ☐

No ☐

Availability of technical support on demand

Yes ☐

No ☐

**Stage 3:Design**

To plan the desired learning outcomes, lesson plans, and appropriate testing methods

A. *Course learning outcomes*

Preservice teachers will be able to define/identify/indicate/label key elements

Preservice teachers will be able to understand/compare key elements

Preservice teachers will be able to apply knowledge to the new situation

B. *Lesson plans*

Based on lesson plan template

- Lesson objectives
- Gain attention and inform objective
- Recall and present the content
- Performance and feedback
- Enhance retention transfer to new situations

C. *Test*

Written

Presentation

Demonstration

**Stage 4:Develop**

To create actual materials and tests as designed in the previous phase

A. *Create materials*

List of content, pedagogy and technology for each learning outcome

| | |
|---|---|
| Content | |
| Pedagogy | |
| Technology | |

*(Make sure to cover all the materials)*

B. *Draft a lesson plan (based on template)*

Assemble content, pedagogy and technology to compose the lesson plan

-----------------------------------------------------------------------------------------------------

-----------------------------------------------------------------------------------------------------

(*Make sure to cover all the materials)*

**Stage 5: Implement**

To carry out the lesson and engage the preservice teachers in class activities

A. *The lesson plans*

Put the plan into action

-----------------------------------------------------------------------------------------------------

Monitor and support the preservice teachers' reaction to content, pedagogy and technology

| Content | Pedagogy | Technology |
|---|---|---|
| | | |

**Stage 6: Evaluate**

To assess the quality of the instructions, lesson plans and its changes on the learning outcomes of the preservice teachers

A. *Learning outcomes*

Conduct test

| Written | Presentation | Demonstration |
|---|---|---|
| | | |

B. *Lesson plan*

Review content, pedagogy and technology for materials

-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------

**ii) To design and develop a technology-integrated lesson for the main study**

## Lesson Plan Template

| Course Name: | Chapter: | Duration of Class: |
|---|---|---|

| | |
|---|---|
| **Lesson Objectives:** | To know what the instructors needs teach and what preservice teachers' need to learn and understand by the end of the class. |

Topic of the lesson

Preservice teachers need to learn

Preservice teachers need to understand/ be able to do at the end of class

***STEP 1***

| | | |
|---|---|---|
| **Gain Attention and Inform Objective:** | • To ensure preservice teachers are ready to learn while the instructors teaches the lesson.<br>• To inform preservice teachers of the objectives/outcomes to help them understand what they are to learn during the course. | *Time:* |
| *Contents* | *Pedagogies* | *Technologies* |
| • Lesson keyword<br>• Lesson objective | Open questions, Ice breakers, Rubrics and many more. | Black-board, PowerPoint with over-head projector, YouTube videos, and many more. |

***STEP 2***

| **Recall and Present the Content:** | • To help preservice teachers make sense of new information by relating it to something they already know or to something they have already experienced.<br>• To present the content effectively. | *Time:* |
|---|---|---|
| *Contents* | *Pedagogies* | *Technologies* |
| • Preservice teachers' previous experiences/concepts<br>• Organize and chunk content in meaningful way<br>• Provide examples | Demonstration, Readings, Web discussion, Discussion, Lecture, Game, Peer work, Quizzes and many more. | Mobile phones, VCD, PowerPoint with over-head projector, YouTube videos, social network and many more. |

**_STEP 3_**

<table>
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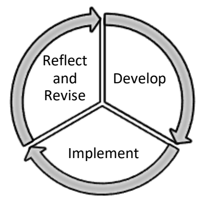
<tr><td><ul><li>Elicit preservice teachers activities</li><li>Elicit recall strategies</li><li>Help preservice to integrate new knowledge.</li><li>Confirmatory feedback</li><li>Analytical feedback</li></ul></td><td>Role play and many more<br><br></td><td colspan="2">PowerPoint with over-head projector, Word, Excel, Google application, YouTube videos and many more</td></tr>
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**Appendix 12**: Worked Examples for the Further Study

**i) To utilize key phases and key components of an elaborated TPACK-integrated ID model for the further study**

**Stage 1: Analyze**

To identify the general characteristics of the preservice teachers and their level of prior knowledge.

C. *General characteristics of preservice teachers*

Gender

| | | | | | |
|---|---|---|---|---|---|
| Male | | Female | | Other | |

Age group

| | | | | | |
|---|---|---|---|---|---|
| 10's | | 20's | | 30's | |

English language proficiency

*(Circle the most appropriate one)*

| Low | Low-medium | Medium | High-medium | High |
|---|---|---|---|---|
| | | | | |

Ownership of technological tools

| Laptop | Desktop | Recorder | Mobile | Tablet | Others |
|---|---|---|---|---|---|
| | | | | | |

Ownership of technological applications

| Word | Excel | PowerPoint | Paint | Moviemaker | Others |
|---|---|---|---|---|---|
| | | | | | |

D. *Prior knowledge of preservice teachers*

Teaching practice experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

Technological experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

Social media experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

Content experiences

| | | | | | |
|---|---|---|---|---|---|
| Little | | Some | | A lot | |

**Stage 2:Explore**

To investigate the possibility of available contents, technologies, and human resources.

D. *Content resources*

Availability of references (books, magazines, journals etc.)

Availability of electronic databases

E. *Technology resources*

Availability of technological tools and applications (Screen, Skype, Word etc.)

Availability of alternatives (of power) during power outages

Availability of computers

Availability of over-head projectors

Availability of various technological tools (scanner, printer etc.)

Availability of internet/Wi-Fi

Yes ☐

No ☐

F. *Human resources*

Availability of class-support on demand

Yes ☐

No ☐

Availability of technical support on demand

Yes ☐

No ☐

**Stage 3: Develop**

To plan and create the desired learning outcomes, lesson plans, and appropriate testing methods

*D. Course learning outcomes*

Preservice teachers will be able to define/identify/indicate/label key elements

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------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------

Preservice teachers will be able to understand/compare key elements

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Preservice teachers will be able to apply knowledge to the new situation

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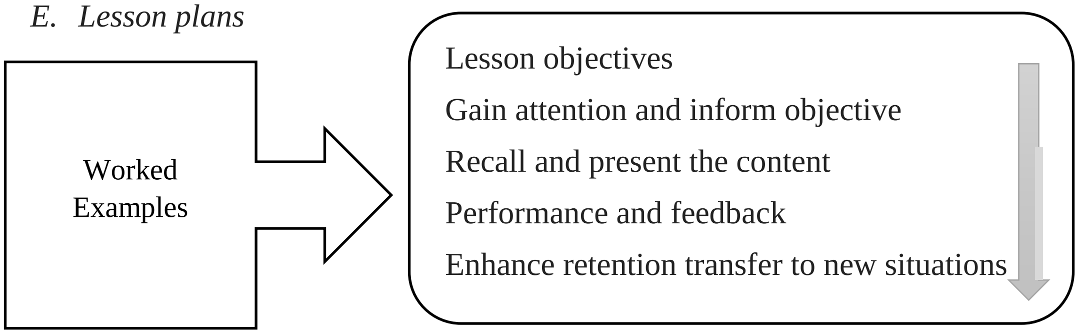
------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------

*E. Lesson plans*




*F. Test*

Written

------------------------------------------------------------------------------------------------

Presentation

------------------------------------------------------------------------------------------------

Demonstration

**Stage 4: Implement**

To carry out the lesson and engage the preservice teachers in class activities

B. *The lesson plans*

Put the plan into action

-----------------------------------------------------------------------------------------------

**Stage 5: Evaluate**

To assess the quality of the instructions, lesson plans and its changes on the learning outcomes of the preservice teachers

C. *Learning outcomes*

Conduct test

| Written | Presentation | Demonstration |
| --- | --- | --- |
| | | |

D. *Lesson plan*

Review content, pedagogy and technology for materials

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**ii) To design and develop a technology-integrated lesson for the main study**

## Lesson Plan Template

| Course Name: | Chapter: | Duration of Class: |
|---|---|---|

| | |
|---|---|
| **Lesson Objectives:** | To know what the instructors needs teach and what preservice teachers' need to learn and understand by the end of the class. |

Topic of the lesson

Preservice teachers need to learn

Preservice teachers need to understand/ be able to do at the end of class

***STEP 1***

| **Gain Attention and Inform Objective:** | • To ensure preservice teachers are ready to learn while the instructors teaches the lesson.<br>• To inform preservice teachers of the objectives/outcomes to help them understand what they are to learn during the course. | *Time:* |
|---|---|---|
| *Contents* | *Pedagogies* | *Technologies* |
| • Lesson keyword<br>• Lesson objective | Open questions, Ice breakers, Rubrics and many more. | Black-board, PowerPoint with over-head projector, YouTube videos, and many more. |

*STEP 2*

<table>
<tr><td>Recall and Present the Content:</td><td colspan="2"><ul><li>To help preservice teachers make sense of new information by relating it to something they already know or to something they have already experienced.</li><li>To present the content effectively.</li></ul></td><td>Time:</td></tr>
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<tr><td><ul><li>Preservice teachers' previous experiences/concepts</li><li>Organize and chunk content in meaningful way</li><li>Provide examples</li></ul></td><td>Demonstration, Readings, Web discussion, Discussion, Lecture, Game, Peer work, Quizzes and many more.</td><td colspan="2">Mobile phones, VCD, PowerPoint with over-head projector, YouTube videos, social network and many more.</td></tr>
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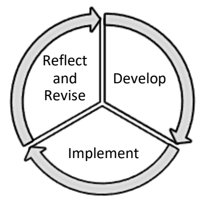

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