Initial Survey Validation for the Impact of Intellectual Capital on Frugal Innovation

Jayamalathi Jayabalan[1], Magiswary Dorasamy[2*], Murali Raman[3]

[1]*Faculty of Accountancy and Management, University Tunku Abdul Rahman, Kajang, Selangor, 43000, Malaysia*
[2]*Faculty of Management, Multimedia University, Persiaran Multimedia, Cyberjaya, 63100, Malaysia*
[3]*Asia Pacific University, Kuala Lumpur, 57000, Malaysia*

Abstract. The rapidly developing Covid-19 epidemic has resulted in nationwide lockdowns, putting many higher learning institutions (HLIs) at risk of extinction due to low profitability and limited finance. This upheaval has increased the pressure on institutions to capitalize on their intellectual resources and develop new economic models. HLIs are turning towards digital transformation as e-learning has become the new normal. This paper explains how pretest and pilot tests were used to improve the methodological reliability of research instruments and suggests that it should be a common step in research instrument development. Pretest, which consists of expert review, cognitive interviewing, and pilot testing, were carried out to manage challenges due to dissimilar context emerging from geographic, linguistic, and cultural differences as the instrument was adopted from past literature. Six professional experts were chosen for face validation, followed by a cognitive interview with 10 ten respondents from the actual respondent's list, which is the management of private university listed in SETARA Listing 2018. Pilot testing consisting of 30 respondents was conducted in the second stage to check reliability and validity. Results from expert review and cognitive interviewing allowed the researcher to quickly resolve issues based on 'respondents' feedback on the wording problems, relevance, and usability of the questionnaire. The results from the pilot test reliability analysis revealed that the scales had good internal consistency. Researchers were able to alter research instruments and enhance the research design because of the detailed pretest and pilot study conducted, which will guide the substantive investigation. This was an important aspect of the pretest and piloting phase since it allowed us to identify issues with the instruments' efficacy and the model transferability to the Malaysian private HLIs context.

Keywords: Frugal innovation; Intellectual capital; Information technology capability; Pre-test; Pilot test

1. Introduction

In 'today's competitive environment, HLIs seek opportunities for survival and development, which usually entails substantial organizational structure shifts. Competition among HLIs for financial and human-capital resources primarily aims to raise research funds and attract and retain highly talented academicians and students. In terms of public and private HLIs, Malaysian public HLIs have more academic resources and a higher reputation than private HLIs. Thus, they stand a greater advantage in being able to address

the demands of students and attract more public donations and institutional support (Anis et al., 2018). As a result, investigating the performance and growth of Malaysian private higher education institutions is the important academic topic.

Private HLIs need to investigate survival strategies as their cost of delivery is unsustainable to address issues such as reducing the number of student enrolment, increasing number of student drop-out, increasing cost of student enrolment and collaboration with industry. In the extensive education market, there is always continuous demand to introduce new online programs and services to attract new recruitment and design low-cost teaching and learning methods rather than traditional teaching. Therefore, private HLIs must operate efficiently and become student's first choice whilst continuously reducing delivery costs. Besides that, HLIs needs to provide rationale programs and curriculum focusing on real-world demand, enhancing employability upon graduation.

There are internal and external resources that can impact HLIs operations. Knowledge-based view will be utilized to investigate the amount and qualities of internal resources such as human resources and structural resources that HLIs possess as it can influence an organization's growth and performance (Barney,1991). In terms of external factors, relational resources will provide HLIs with several benefits, including the ability to manage competitive tensions, find effective and resource-efficient solutions, secure better learning advantages, and deal with uncertainty and volatility in the environment.

Intellectual capital (IC) is a crucial element for value creation in an organization (Lev, 2001). Although more research on IC are mainly focused on commercialized private firms and profit seeking firms (Giampaoli et al., 2017), there are still studies conducted in public and non-profit organization (Sangiorgi & Siboni, 2017) .IC is seen as a source of sustainable competitive advantage (Dezi et al., 2018), able to develop strategies to promote innovation and continuous growth (Manes-Rossi et al., 2018), Alonso-Gonzalez et al. (2018) because Knowledge-based internal and external resources that could play an important role in an economic and social context. Therefore, prudent management of IC, which inclusive human capital, structural capital, and relational capital, will be able to ensure the effectiveness of the processes and the capability of the entities to create value. According to Bencsik (2020), the organization leaders must familiarise themselves with the new requirements, concepts, tools, business models, and relationships with customers and partners in order to prepare for the transition, in addition to the workers and technological systems. There is a shift in the role of universities which traditionally focuses on teaching and research to create innovative solutions for business through knowledge creation, application, and dissemination (European Commission, 2013).

Frugal innovation (FI) is gaining popularity worldwide, not just in emerging economies, but also in developed nations. According to (Tiwari et al., 2017), various studies have highlighted the growing importance of low-cost goods and services, which indicates the growing demand for cost-effective solutions and the growing demand for cost-effective solutions and the relevance of FI. FI concepts emphasize on inventing resource restrictions to maximize value for money. The three defining criteria of FI are substantial cost reduction, concentration on core functionalities, and optimized performance level (Weyrauch & Herstatt, 2016). Much of the research on FI focuses on defining the idea as well as the method of developing inexpensive inventions through FI. However, the application and function of FI in the business model, on the other hand, also becomes more essential in the transmission of FI, and it may also serve as an alternate approach to promote frugality.

Information Technology Capabilities (ITC), and digitalization plays an important role in business model to run operations more efficiently and cost-effectively which can facilitate FI application. Digitalisation conserved time and resources by allowing for simpler

and more effective innovation methods. Furthermore, digitization opens possibilities for creating more accessible human-machine interfaces in applications, reducing user complexity. IT frequently enables low-cost and design value-sensitive innovations, which are examples of frugal innovations (Bhatti & Ventresca, 2013, Rao, 2013). One of the aims of frugal innovation is minimizing technological sophistication without having to compromise user value. According to Berawi (2017), Businesses and the market as a whole have benefited from technological advancements, such as cost-effective and efficient goods and services. Modernizing company businesses by integrating physical resources, digital technologies, and human creativity is a crucial stage in the innovative business transformation that could give an organization an advantage oveits competitors (Berawi et al., 2020). Koroleva & Kuratova (2020) examined the relationship between the economy's digitization and the standard of higher education in Russian regions and found out that higher innovative activity levels were associated with higher quality higher education.

According to Bezhani (2010), intellectual capital (IC) has been an interesting topic among academicians, shareholders, and the government. However, the value of IC is rarely focused on in emerging economies, especially in private HLIs (Tiwari et al., 2016), and its relationship with costs and performance efficiency (Barbosa et al., 2016). Hence, examining the association between resource factors such as Intellectual capital (IC), ITC, and frugal-based performance indicators will yield practical implications for institutional governance and the basis for theoretical underpinnings of academic research as valuable insights for HLIs in other countries experiencing comparable challenges.

1.1. Problem Statement and research objectives

The rapidly developing Covid-19 epidemic has resulted in nationwide lockdowns, putting many higher learning institutions (HLIs) at risk of extinction due to low profitability and limited finance. This upheaval has increased the pressure on institutions to capitalize on their intellectual resources and develop new economic models. HLIs are turning towards digital transformation as e-learning has become the new normal.

Even HLIs with access to the internet and IT infrastructure for teaching and learning applications are doubtful to adopt a completely digitalized approach. There is a dearth of staff support and engagement, technical understanding, professional employees, and staff training in information technology (Cabero-Almenara et al., 2021). On the other hand, education institutions must remain relevant to preserve long-term viability. Industry developments and needs must be reflected in the programs or courses offered.

Therefore, due to the changing economic conditions, private HLIs are extremely exposed to even little fluctuations in income. As a result, financial stability and long-term commercial viability are critical to their existence. Frugal innovation (FI) may be able to assist ailing HLIs in continuing their innovative activities in the absence of significant financial investment and high resource shortages.

The researchers adopted research instrument items to develop a questionnaire that measured research objectives to investigate the relationship between Intellectual Capital, Information Technology Capability and Frugal Innovation. A pretest and pilot studies were c conducted to manage challenges due to dissimilar context emerging from geographic, linguistic, and cultural differences as the instrument was adopted from past literature. Expert review and cognitive interviewing were employed as validating tools to ensure clarity and relevance in the study population. This paper explains how pretest and pilot tests were used to improve the methodological reliability of research instruments and suggests that it should be a common step in instrument creation. Since the pilot test and subsequent analysis were undertaken for small sample size, it limits the ability to generalize and conclude the findings to larger groups of population or institutions.

Given that backdrop, this paper aims to evaluate face and content validity and acceptability of the questionnaire instrument developed to investigate the variables intended in Malaysian private HLIs. This paper is organized as follow: section 2 literature review on the main concepts of the research is explained, section 3 describes the research instrument utilized for this study, section 4 explains the method and process of pretest and pilot test conducted, and section 4 represents result analysis, section 5 outlines the conclusions of this paper.

2. Literature Review

2.1. Intellectual Capital (IC)

Intellectual Capital (IC) is believed to have an influence on frugal innovation. According to Stewart (1997), IC is intellectual content that has been structured, acquired, and exploited to generate wealth by creating a higher-valued asset. According to Bontis (1998), IC is described as human capital (HC), which consists of experience, skills, employee development, teamwork; structural capital (SC) includes databases, proceedings, patents, licenses, trademarks, manuals, and organizational structures and Relational capital (RC) which focuses on networks of relationships. IC encompasses a variety of nontangible in HLIs, such as business processes, patents, member skills, competencies, talents, innovation capacity, reputation, and relationships with external parties. Several demands for research to enhance the management of IC in HLI setup have been made (Pedro et al., 2019). Business models are often linked to resource acquisition and allocation in -Knowledge Based View (KBV), an extension of Resource Based View (RBV). Extraordinary value will be created through leveraging intangibles and knowledge assets. To attain FI in private HLIs, there is a scarcity of research that examines the links between organizational IC aspects and ITC.

2.2. Information Technology Capabilities (ITC)

In the digitalized era of the knowledge economy, technical capabilities have grown in prominence, while information technology (IT) is considered an intangible capacity that may considerably improve organizational performance.IT capability development is critical for deploying and managing IT-based Knowledge and resources for improved performance. Hence, based on dynamic capability theory, ITC will enable innovative processes to increase productivity, improve customer relationships, and reduce operational costs. In addition, according to Price & Kirkwood (2014), there is a lack of IT expertise, commitment, or objective to undertake digital transformation effectively. Many organizations, especially private HLIs, have been confronted with issues such as a lack of technological integration, slow adoption of IT for strategic purposes, and a lack of understanding and application of technology in their operations. As a result, there is still an issue that most institutions invest a significant amount of money in IT system development that fails to deliver the anticipated outcomes and value to the organizations. As a result, Knowledge, skills, and abilities play a significant role in establishing IT competency inside an organization. However, this study focuses on the intangible usage of IT skills to examine its impact on FI and performance.

2.3. Frugal innovation

Frugal innovation (FI) is designed to help businesses with limited resources achieve greater social and economic value (Tiwari et al, 2016). It is a new business model that emphasizes resource efficiency, low-cost products and services, and product and service functionality and performance (refer to figure 1).

Researchers are becoming increasingly interested in frugal innovation, which began in emerging nations and is now being applied in Western countries. FI necessitates resource

efficiency and low-cost products and services while keeping a high degree of quality (refer to Figure 1). Figure 2 shows the criteria for FI, and Figure 3 shows the FI concept.
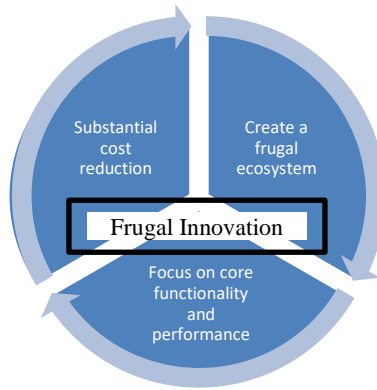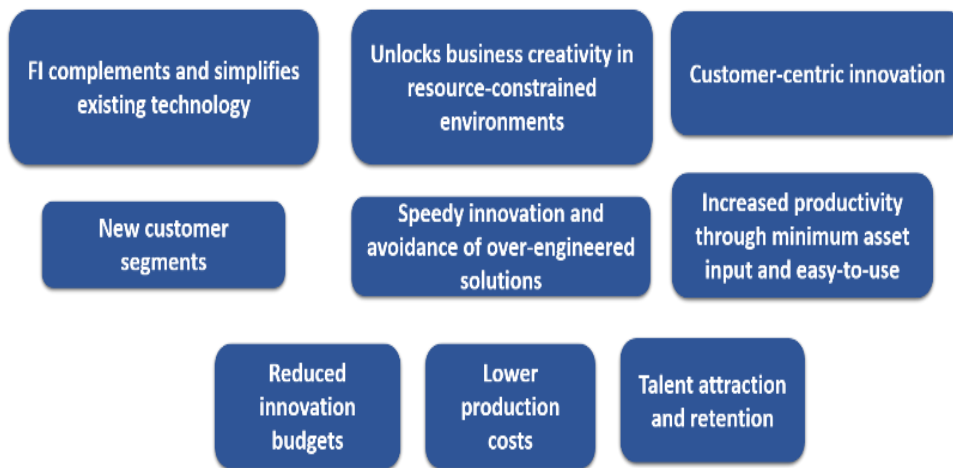

Figure 1 Frugal innovation model

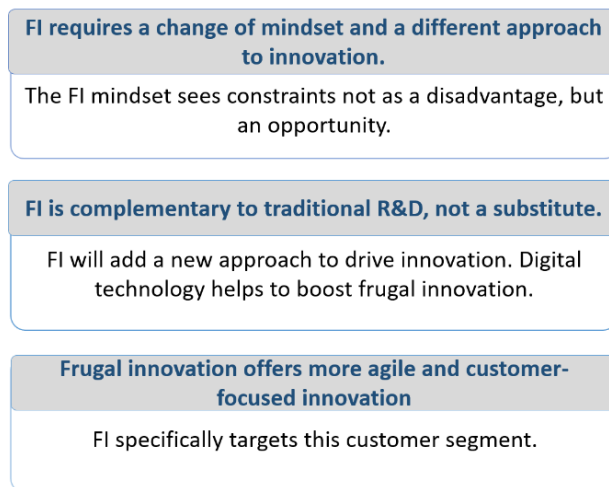**Figure 2** Frugal innovation criteria

Figure 3 Frugal innovation concept

With limited physical and financial resources, FI includes managing the entire value chain, which improves product quality and reduces costs. As a result, effective resource management, complete utilization of existing components, adoption of cost-effective technology, and streamlined design can help a HLIs save costs. This research aims to fill a deficiency in the literature on how IC may have a substantial influence on FI in HLIs, allowing

them to do ""more with fewer resources"". A conceptual framework is developed based on knowledge-based view theory and dynamic capabilities theory.

3. Methods

3.1. Research Instrument

Pretesting is the stage of survey method where questionnaires are evaluated on participants in the target population to assess the validity and reliability of the survey instruments before their final distribution. Pretesting is frequently seen as essential to the creation of survey questionnaires and is also essential to enhance data collecting for quality-of-life research. It uses a range of techniques or combinations of techniques. The most crucial factor in creating and assessing measuring instruments is validity. The degree to which an instrument actually measured what it was supposed to measure is known as validity. In other terms, an instrument that measures what should be measured is said to be valid. The researcher employed face validity and content validity in this study to guarantee test validity. Figure 4 shows the summary of the pretesting done for this research:
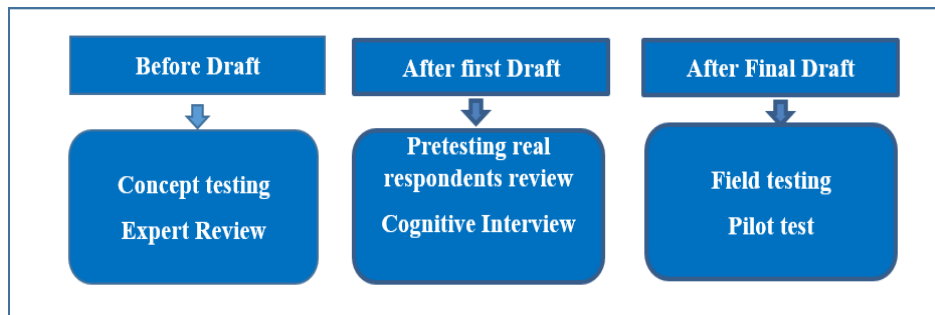

Figure 4 Pretesting process

Face and content validity and acceptability are three factors that need to be considered in a cross-cultural adaptation of the questionnaire. Face validity is a determination of whether an instrument looks to be measuring the area of interest. In contrast, content validity is a determination of whether the instrument's content appropriately covers the domain of interest. Finally, acceptability is defined as the degree to which a respondent finds an instrument acceptable and inclusive of factors such as format and administration time. The following table 1 is constructs and description of measurements:

Table 1 Constructs and description of measurements

Construct	Number of items	Number of questions	Source
Human capital	3	30	Sharabati et al., (2010)
Structural capital	3	30	Sharabati et al., (2010)
Relational capital	3	30	Sharabati et al., (2010)
Information technology capabilities	3	21	New item proposed based on Dynamic Capability theory (Lu & Ramamurthy, 2011)
Frugal innovation	3	9	New item is proposed based on Knowledge based theory (Tiwari et al., 2016).

The questionnaire was divided into four sections that related to a) socio-demographic characteristics of respondents; b) Intellectual Capital dimension including Human Capital, Structural Capital, and Relational Capital; c) Information Technology Capability and d) Frugal innovation.

3.2. Pretest process

Expert reviews are widely employed as a questionnaire assessment approach in pretest, although empirical research has been done on them. Six professional reviewers were chosen for face validation, and a standardized rating form was used to analyze questions in the survey questionnaire. The experts for this process were selected based on their experience and affiliations, latest contribution in HLIs, and expertise on the topic using the purposive sampling approach. Sample sizes are typically low, which range from n = 5 for a single round to n = 15 across multiple rounds (Beatty & Willis, 2007). Survey methodologists, subject matter experts from HLIs field, language experts, and others experienced with questionnaire design were selected to detect possible flaws with a survey questionnaire. Two main goals of expert review are to expose issues with a questionnaire survey so that they may be fixed before it goes into the field and to categorize things into subgroups that are less likely to have measurement errors. E-mail was used to contact the experts and invite them to participate. The experts chosen preferred to maintain their anonymity.

This process is followed by cognitive interview which was conducted with ten respondents from the actual 'list, which is the management of private universities listed in SETARA Listing 2018. Cognitive interviewing proved to be valuable for face and content validation of the questionnaire during pretest. The main purpose of cognitive interview is to provide evidence on content validity to determine items that are misaligned between the 'interpretation and the'researcher's intention. The items are tested for their clarity and relevance and to identify problematic questions that will not be able to provide expected respondents. According to Collins (2003), the cognitive interview is intended to determine whether the respondents read and understand the questions as worded and whether respondents able to answer them in the way the researcher required. It also allows the researchers to find out whether the information can be retrieved or available. Cognitive Interviews (CI) can be utilized in the creation of scales to guide item revision decisions, as well as give evidence of validity based on test content and response processes (Castillo-Díaz and Padilla (2013).

Private universities are large organizations with various levels of leadership. A questionnaire survey will be conducted with academicians holding a managerial position as the representative of the institutions such as chancellor, vice chancellor, directors, deans, deputy deans, and HODs from private universities to obtain their general views and perspectives. Respondents can work in various departments such as business studies, tourism management, finance, architecture, psychology, and mechanical engineering will be used for this research.

Foreign branch Universities are excluded from the population sample as university are controlled and operated by foreign education providers. Furthermore, public universities are also excluded as their funding mechanism, cost structures, budget allocation, and academic program are different and controlled by the government and ministry. Therefore, the respondents in public universities and foreign branch universities will not be able to provide valid data. Researchers usually used the following criteria (Table 2) as the selection criteria:

Table 2 Respondent selection criteria

1st Stage	Private universities (53)
2nd stage	Private universities based on SETARA '18'
3rd stage	Academic Management staffs (senior Management and faculty management)

The respondents with similar attributes are selected based on the actual 'respondents' sample list to determine the content validity of the instrument used in the survey. Through the cognitive interview method, the researchers aim to gain a few understandings of the survey questionnaire as follows:

a) To understand how respondents interpreted the question from their perspective and determine whether it is similar to what the researcher required and intended (Collins, 2003)
b) To determine items that that need a reorganization of sentence structure and wordings to avoid misunderstanding and missing data
c) To check on the relevance of language or term used based on the context, culture and geographical settings to avoid misinterpretation (Hurst et al., 2015)
d) to identify the estimated time taken to complete the survey (Hurst et al., 2015)

Researchers used the think-aloud approach, verbal probing, and observation to measure how respondents comprehended and responded to questions. As participants read each survey question aloud, the researcher will ask the respondents to articulate their ideas and understanding of the concept and then seek to answer the question as they understood it (Hurst et al., 2015). Probing will discover terms that may be misunderstood, allowing the respondent to restate the inquiry in their own words. These observations will provide information regarding the suitability of the research questions, terms, themes, layout, validity, and credibility (Hurst et al., 2015). The following Figure 5 below shows the cognitive interview process:
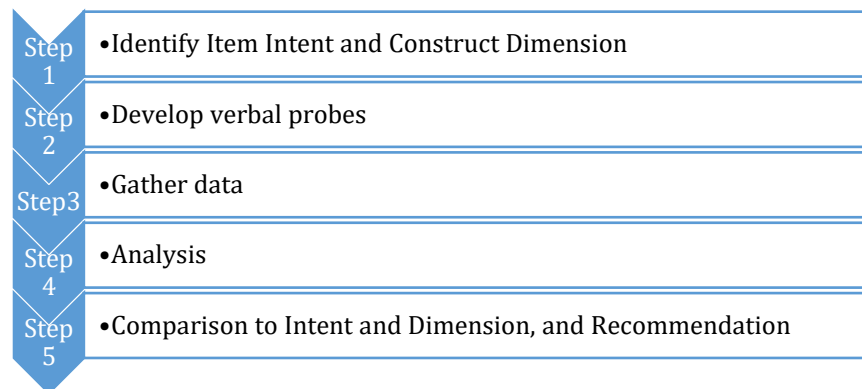

Figure 5 Cognitive process

3.3. Pilot Test Process

The content validation of the survey questionnaire using a pilot test was the second stage to check on the reliability and validity consist of 30 respondents. It was a 120-item questionnaire modified after the pretest to investigate academic 'leaders' perceptions regarding IC, ITC, and FI. Respondents are academicians with management positions in private HLIs.

4. Results

4.1. Results for Expert review

Six Panel experts were requested to give a qualitative comment. The experts were asked to indicate the suitability of the interval measurement scale used for this item and evaluate whether the questions are in perfect match, moderate match, and poor match to the construct. The following Table 3 summarizes the results of the expert review:

Table 3 Summary result of Expert review

Feedback	General Comments
1. Format acceptable.	Avoid lengthy sentence and make it clear cut sentences
2. Exclude academicians in the demographic section.	Academicians may not be able to answer all the questions
3. Reduce the number of items.	Too many questions.
4. Split the double-barrel questions.	Question is too long
5. Choose the most relevant items only.	How relevant is this system question? Some are not relevant
6. Need some corrections in sentence structure.	Difficult to answer-need to be general, not too specific
7. Improve the sentence structure and simplify to be more consistent.	Use a Straightforward phrase. Change some of the word choice

4.2. Results for Cognitive Interview

To assure relevance in the local social and cultural context, the language and words used in the higher education and professional categories needed to be familiar to respondents in the private universities in Malaysia. In 10 interviews, issues with the item completeness and understanding, 'respondents' judgment when answering, and responses given were identified. Eighty-two things stayed untouched, 37 items were rephrased, and one item was added, according to the findings. Some of the 'questionnaire's instruction part was also revised. When there is a mismatch between the respondents' judgments and the researcher's aim, alterations are required. 'Respondents' qualitative responses are then utilized to influence modifications to questions. The following Table 4 shows the modification of the number of questions. Even though time-consuming, cognitive interviewing proved to be an effective method for uncovering issues in an instrument that might go unnoticed and undermine its validity.

Table 4 The summary result on questionnaire modification

Construct	Number of questions
Human capital	17
Structural capital	20
Relational capital	18
Information technology capabilities	20
Frugal innovation	10

4.3. Results for Pilot test

Most of the respondents are Chinese (53%), followed by Indians (27%) and Malays 20% (Figure 6). Besides that, most of the respondents have 16 years and above working experience (N = 57%), while 20% with 11 till 15years' experience and 17% with five till ten years working experience. Only 7% of the respondents are with less than 5 'years' experience (Figure 7). This result shows the respondents observed are with vast experience. Based on table 5, the vast majority of the respondents are heads of departments (N = 14, 47%), followed by deputy deans (N = 7, 23%), and deans (N = 5, 17%). From the data collected, there were 37% males and 63% females (Figure 8).
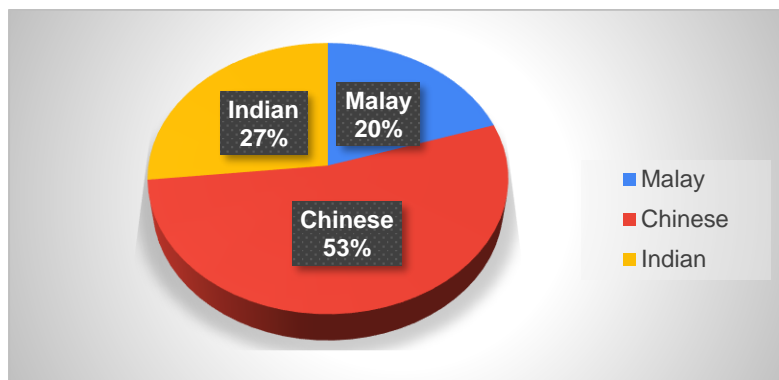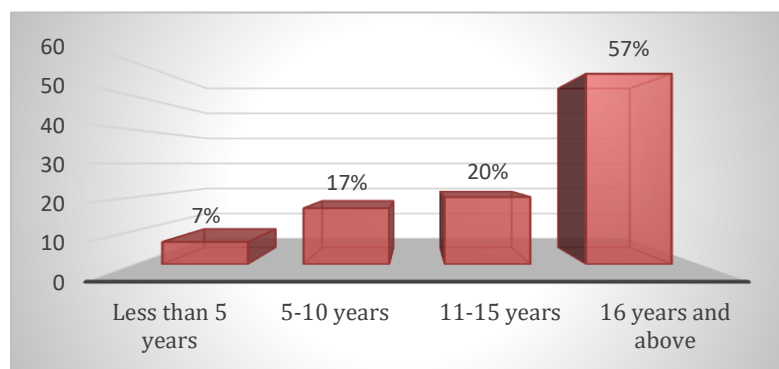
Figure 6 Respondents by Ethnicity
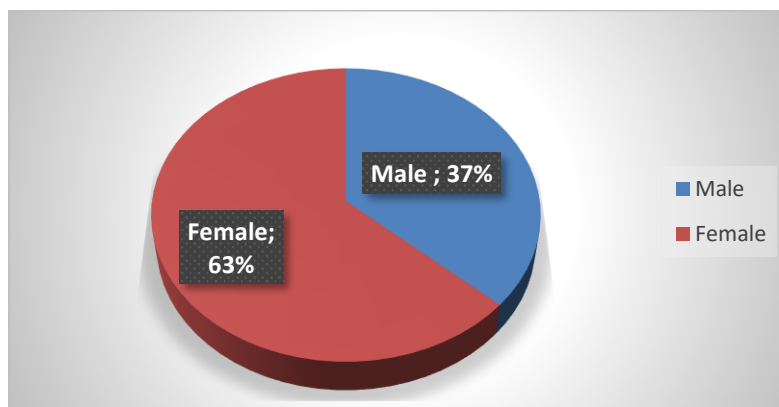

Figure 7 Respondents by Working Experience

Figure 8 Respondents by Gender

Table 5 Respondents by Academic Positions

Academic Leader Position	No	%
Vice-Chancellor/ Pro Vice-Chancellor/ Vice-President/Chief Academic Officer	1	3
Dean/Director	5	17
Deputy Dean/Deputy director	7	23
Head of the department/Head of the Programme	14	47
Programme Coordinators/Assistants	3	10
Total	30	90

The survey instrument's reliability was assessed (Table 6). Results from the reliability analysis revealed that the scales had good internal consistency. The 'Cronbach's alpha coefficients ranged from a low of 0.74 to a high of 0.983. Therefore, all variables are

accepted as the Cronbach Alpha score is more than 0.60, indicating that the items have strong internal consistency and stability (Creswell, 2018). Results from the pilot study revealed that the initial version of the questionnaire collected reliable data. No further changes were considered necessary for the questionnaire.

Table 6 Reliability Test

Main Constructs	Constructs	Dimensions/Measurements	Cronbach alpha	Number of item
Intellectual Capital	Human Capital		0.931	
		Learning and education	0.853	6
		Experience and expertise	0.74	5
		Innovation and Creativity	0.899	6
	Structural Capital		0.961	
		Systems and programmes	0.908	7
		Research and development	0.935	7
		Intellectual Property Rights (IPRs)	0.95	6
	Relational Capital		0.975	
		Strategic alliances, licensing and agreement	0.948	6
		External stakeholder	0.941	6
		Knowledge about students	0.943	6
Mediating variable	Information technology Capability		0.983	
		IT infrastructure	0.956	6
		IT business spanning	0.975	6
		IT proactive stance	0.969	8
Dependent Variable	Frugal Innovation		0.959	
		Substantial cost reduction	0.737	3
		Create a frugal ecosystem	0.94	4
		Focus on core functionality and performance	0.964	3

5. Conclusions

Pretest consisting of expert review, cognitive interviewing and pilot testing allowed researchers to uncover non-problematical and problematical questionnaire items. In addition, it was noticed that the questionnaire's layout might be improved. Pretest proved to be an unavoidable method of research instrument development, although the process is time-consuming. Besides that, respondents have provided feedback on the problems in the wording, and the relevance and usability of the questionnaire, allowing the researcher to quickly resolve any issues. Face validity improves because of the results being implemented. Hence, pretest ensures that the questionnaires are looking for information that respondents have and can obtain, and all respondents understand the questions in the same way. Pretest ensures that the wording of questions provides respondents with all the necessary information they require to be able to answer them in a way required by the researcher. Identifying problems that may be resolved through a thorough examination of the pretest methods and results from the pilot study by enhancing the reliability and validity of the research. A well-planned and administered pilot study could improve the quality of the research since the findings may be used to influence subsequent stages of the research. As conclusion, researchers were able to alter research instruments and enhance the research design because of the detailed pretest and pilot study conducted, which will guide the substantive investigation. This was an essential aspect of the pretest and piloting phase since it allowed us to identify issues with the instruments' efficacy and the model's

transferability to Malaysian private HLIs. In the present study, after making some minor adjustments to the questionnaire instrument, the findings of this pilot research confirmed that the objectives of the proposed main study could be achieved, and subsequent main research could be conducted. Finally, the fact that the pilot study was undertaken for a small sample size limits the ability to apply the findings to larger groups of populations.

Acknowledgments

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