

Personal experiences with mixed methods research in Papua New Guinea

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Abstract

Any research has to be well designed and applied in order to be reliable, valid and convincingly acceptable. In certain local circumstances, this may present challenges because of limitations in material, human and financial resources. The demand for greater transparency, credibility and trustworthy contributions to new knowledge adds increased challenges. This paper reports on experiences of the author with mixed methods based research applied to investigate the impact of mobile phones on socio-economic development in Papua New Guinea. In the reported study, mixed methods proved invaluable throughout the data collection and analysis phases enabling increased illumination and culminating in the successful completion of the research.

Keywords: Mixed methods, concurrent mixed methods, sequential mixed methods, validity and reliability, quantitative and qualitative methods.

Introduction

It serves a useful purpose to share experiences gained through research concerning the contextualised perspectives of ontological, epistemological and methodological paradigms. The methodology informs the specific methods to ensure coherence and stability in research (Venkatesh, Brown, & Bala, 2013). Clearly identified and used methods are important for transparency and accountability of the research process ensuring reliability and validity of the results (Golafshani, 2003). This may lead to convincing research outcomes.

This paper aims to discuss mixed methods research (MMR) from a PNG context on how the paradigms guided the data collection, analysis and interpretation process. The importance of this paper lies in disseminating contextual application of the mixed methods approach across the readership including aspiring researchers in PNG.

Advantages and challenges of using mixed methods drawn from investigating the impact of mobile phones on socio-economic development in PNG are presented. MMR is defined and the appropriate stages of the process and the details of how illumination was achieved are discussed. Though researchers may favour either qualitative or quantitative methods as separate strands, this paper reports that the use of mixed methods offers a pragmatic option for credible outcomes. Partial research data from quantitative and qualitative strands are used to illustrate how the data were compared, contrasted and interpreted through the theoretical framework.

Research proposal

More often than not, a post graduate degree research study or indeed a research study of any kind is preceded by an appropriate research proposal. While the proposal provides a guide, it may also be used to source funding or to attract potential supervisors by demonstrating that the proposed topic is substantial enough to be investigated. For these reasons, writing a good research proposal needs careful thought, mapping the current knowledge on the subject and the methodology to be used in the research. A good research proposal delineating the philosophical and methodological paradigms informing the overall investigation process can potentially be a pathway to good quality research.

Among other things, research objectives, methodology and research questions are identified during the proposal stage (Onwuegbuzie & Leech, 2006). The proposal stage also identifies the research questions which can be influenced by the philosophical paradigms upon which the investigation may be situated. For this study using mixed methods, the researcher formulated research questions which are constructivist rather than theory testing questions. The concerned questions are as follows:

- What are the primary attitudes toward and uses of mobile phones?
- What are the cultural aspects of mobile phone usage?
- What are the aspects of mobile phone usage in healthcare?
- What are the aspects of mobile phone usage in schools?
- What are the social aspects of mobile phone usages?
- What are the economic aspects of mobile phone usage?

Research questions give rise to the type of data to be collected for the intended purposes (Onwuegbuzie & Leech, 2006). For the reported study, the research questions were developed through extensive literature review, previous experiences and the practical need to study the impact and influences of mobile phones in PNG. The structure of the above research questions is relational in that specific aspects of mobile phone usages are being investigated.

In consideration of the foregoing, it was considered appropriate to use mixed methods methodology. This enabled the construction of meaning to answer the questions by mixing quantitative and qualitative techniques in order to assess the impact of mobile phones on socio-economic development.

Justifying the research

Research has to be justified because it consumes opportunity and economic resources. Moreover, research covering information and communication technology (ICT) initiatives in PNG is still at its infancy. An extensive review of international and national literature identified gaps which formed the main research questions. The uniqueness of the research questions provided the impetus for the investigations to be undertaken, warranting allocation of

resources. There was justification that the investigation would contribute to knowledge in PNG and mixed methods would be the best approach in the investigations.

Mobile phones being a recent innovation provided a window of opportunity for the research to be undertaken within a set timeframe. This is true because technological changes are constant and rapid. Mixed method research offered advantageous application with which data were collected, analysed and interpreted to adequately satisfy the research questions. The triangulation of both strands of data identified areas of congruence and incongruence with paradoxes which were then meaningfully interpreted. The results from the regression tests of the quantitative strand were compared and contrasted with the themes from the qualitative strand.

Research design

Undertaking higher degree research requires that the process is transparent and intellectually sound. Clear articulations provides the platform upon which the whole research process has to be situated upon so that it is intellectually and scientifically credible.

The research methods should be very clear. In the case of mixed methods, the layout of both quantitative and qualitative methods should be clear, encompassing the *modus operandi* of data collection, storage, coding, entering into the software, cleaning and undertaking exploratory data analysis. These are important steps because each strand should be accorded prudent treatment of data for maximum credibility of results.

For the quantitative strand, the foregoing process is then followed by more stringent tests involving regression analyses to better comprehend the essence of the data. This can be undertaken with software such as Microsoft Excel or Statistical Package for Social Science (SPSS). Open source software is also available on the internet and can be freely downloaded and used for the intended purposes with acceptable results.

Insofar as the qualitative strand is concerned, thematic analysis can be undertaken either manually or using the software package. To use manual method requires more time, and can be massive work if transcribed materials are lengthy. The use of software such as NVivo or Atlas-ti can make the process of thematic networks convenient by creating models and coding the themes following these models. For the reported study, NVivo was used to formulate models guided by the research questions and these models then directed the coding process into nodes for the final thematic networks.

Defining mixed methods

Investigation using mixed methods involves collecting, analysing, and interpreting quantitative and qualitative data in a single study involving an

underlying phenomenon (Onwuegbuzie & Leech, 2006). Mixed methods research has logical and intuitive appeal lending itself to be increasingly utilised by researchers for their investigations. Creswell (2011) defines mixed methods as follows:

Mixed methods study involves the collection or analysis of both quantitative and qualitative data in a single study where the data are collected concurrently or sequentially, are given specific priority, and involve the integration of the data at one or more stages in the process of research (p. 212).

Mixed methods research is concerned with the parallel collection of both quantitative and qualitative data. Survey forms were used to collect quantitative data while probing questions enabled interviews for the qualitative strand. Equal importance was accorded to each strand of data, where concurrences, differences and paradoxes were identified through triangulation. This important feature of mixed methods research enabled the researcher to deepen reflection and construction of meaning from the data.

Concurrent data collection compared with sequential data collection improved the efficient use of time and financial resources as the researcher planned to cover Highlands, coastal and Islands regions of PNG. Moreover, both strands of data were collected in their original form reducing researcher bias.

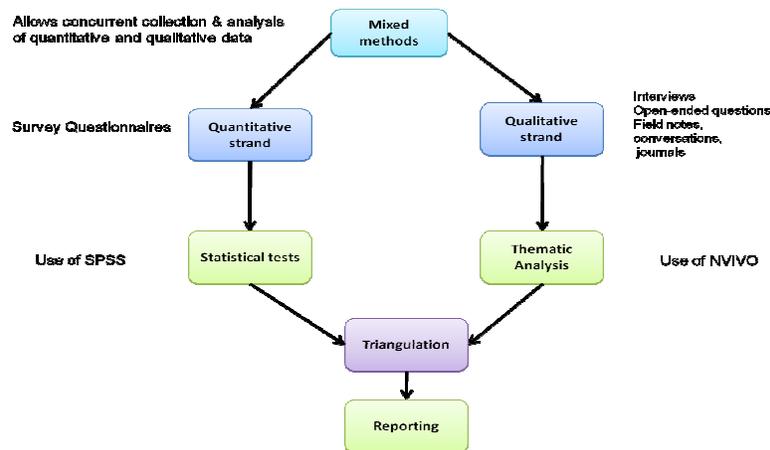


Figure 1: Concurrent mixed methods.

The juxtaposition of data from both quantitative and qualitative strands during the analysis stage revealed interesting factors and themes buried within the huge body of data. Comparing and contrasting of the principal component analyses components with the major themes from the thematic networks proved useful. The use of concurrent mixed method enabled triangulation of strands to offer enhanced illumination on the data for improved construction of meaning (Figure 1).

Triangulation of quantitative and qualitative data proved useful in identifying similarities and differences which were then interpreted with the help of the theoretical framework. This strategy proved useful and offered insights in answer to the research questions.

Novice researchers may also utilise mixed methods to economize on time and money resources in the investigation process. The research topic with the associated questions or hypothesis may lead the researcher to decide on the research methodology. Such was the case for this study. In particular, it was deemed suitable to use quantitative variables to measure attitudes toward and uses of mobile phones to be complemented by qualitative themes. The corroboration of data through triangulation provided better illumination on how mobile phones were being perceived and used.

Challenges in mixed methods research

Challenges facing researchers in PNG, such as lack of recognition for the importance of research in companies and organizations, are compounded by funding limitations in universities and colleges. Research and development are intertwined and inseparable (Rogers, 1983). Whether or not research is undertaken for academic requirements, PNG needs to promote a research culture in all sectors of the economy because it is the way through which proper planning, implementation and monitoring can support development initiatives.

Methodology

Choice of research methodology informs the research design encompassing the sampling technique to be used to collect data and their subsequent analysis (Guthrie & Guthrie, 2012). Also the appropriateness of the methodology depends on the nature of the problem and may be influenced by the availability of human, material and financial resources. Against these considerations, the researcher found that mixed methods methodology was a suitable paradigm to harvest the data to answer the research questions. The relational nature of the research questions and the variables to be used to measure attitudes and perceptions of end users led to mixed methods as the appropriate option to use. The methodology offered the opportunity to maximize the advantages of quantitative and qualitative methods such that corroboration of data through triangulation enhanced illumination.

Sampling design

Quantitative research is based on random sampling, demanding a statistically large sample size due to the requirement to extrapolate and represent a larger population (Wright & London, 2009). Qualitative research on the other hand is based on smaller sample size, that seeks to acquire improved illumination of an issue (Denzin & Lincoln, 2011). In this light, sampling design in mixed methods research presents challenges that must be overcome to satisfy both strands. While circumstances may not favour strictly random sampling for the

quantitative strand, at the minimum, efforts should ensure that statistical power and significance are achieved. These are necessary for both the reliability and trustworthiness of the descriptive and inferential tests conducted from the data. The reported investigation leveraged participant willingness to optimize the sample by collecting N=727 samples across PNG.

When conducted separately, quantitative and qualitative research methods follow well-defined sampling rules. However, sampling in mixed methods is more involved than in single method research (Onwuegbuzie & Collins, 2007) because sampling schemes in mixed methods research need to satisfy generalizability and greater illumination requirements than a single method approach. In general, samples for quantitative strand should be collected on randomized criteria and statistically large enough to enable generalization, while for qualitative data, sampling should be undertaken up to the point where data saturation occurs (Onwuegbuzie & Daniel, 2003). At the data saturation point no new themes are expected to appear. This sampling strategy was adopted in the present study. Participants who inhabit distinct geographical environments and are culturally distinct from each other were sampled to share their attitudes and experiences on the impacts of mobile phones on socio-economic development. This necessitated the sampling criteria to be coherent with the overall research objectives, the research questions and the research design (Onwuegbuzie & Collins, 2007).

Validity and reliability

Validity and reliability form important aspects of any research process. While validity is concerned with generalizability or representativeness to the whole population (Teddlie & Yu, 2007), reliability refers to the extent to which meaning creation is consistent with the mixed methods design (Collins, Onwuegbuzie & Jiao, 2007). In mixed methods research, validity and reliability reflect the quality of the research and sampling design strategies upon which data collection, validation, analyses and interpretation are developed. For the reported concurrent mixed methods based study, the quantitative strand used descriptive and inferential statistics tests. The qualitative strand employed thematic networks from data collected from interviews and observations.

For research to be convincing to readers, it serves useful purposes to ensure that there is validity and reliability in how the results are analysed and interpreted. Often this can be reflected through good research and sampling design coherent with philosophical paradigms and theoretical assumptions upon which investigations are situated (Onwuegbuzie & Johnson, 2006). The reported study used constructivist epistemology with diffusion of innovations theory to create meaning from descriptive and inferential analyses.

Moreover the sampling design encompassed both quantitative and qualitative requirements where sampling scheme and size were ensured to satisfy both strands. As the research intended to cover the whole of PNG, the samples were taken from the Highlands, Coastal and Islands regions. Survey forms were used to capture quantitative data with a statistically large sample for

representativeness and generalizability while interviews were conducted through probing questions for the qualitative strand.

Credibility and trustworthiness

Researchers should ensure due diligence at all stages of the investigation process to guarantee credibility and trustworthiness to the readership. The collected data should be kept safe and secure during the coding and analyses stages to ensure treatment integrity and significance enhancement (Onwuegbuzie & Leech, 2006). Treatment integrity concerns unbiased assessment of interventions through mixed methods. In the reported study, data security was achieved by coding, cleaning and conducting exploratory data analysis for familiarity before detailed tests. Also significant enhancement through mixed methods was obtained through comparing and contrasting principal component analyses components from the quantitative strand with the thematic networks of the qualitative data.

Mixed methods data analysis

One of many challenges facing researchers is to link research questions to quantitative data analyses (Onwuegbuzie & Leech, 2006). Many quantitative analyses call for tests such as measures of centrality, measures of variability and dispersion or analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) as appropriate (Croucher, 2010). If there is no reference to research questions between these statistical tests, readers may gain the impression that statistical analysis occur superfluously (Onwuegbuzie & Leech, 2006). It is therefore important that statistical descriptive or inferential tests applied to the data are justified and relevant to the research questions. In the reported study, principal component analysis was used to reduce the huge body of data, extracting the primary attitudes. The identified primary attitudes were then subjected to ANOVA and MANOVA tests to ascertain whether or not there are statistically significant differences within and between the regions.

Also, the primary attitudes were juxtaposed with the thematic networks from the qualitative strand for further interpretation in response to the research questions. The application of ANOVA and MANOVA tests to the primary attitudes revealed instances of statistically significant differences within and between the regions. Such differences were then viewed together with emergent themes from the respective regions. It turned out that, when seen together, the statistically significant differences manifested social and cultural orientations of the regions.

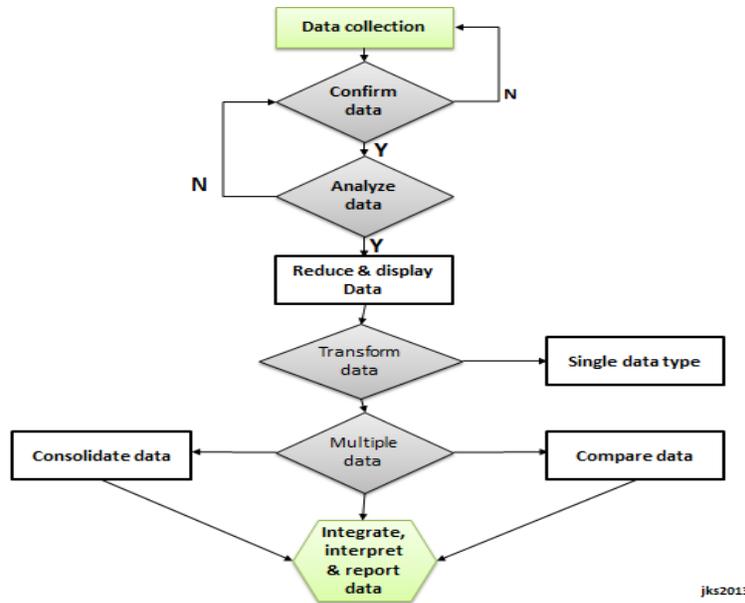


Figure 2: Mixed methods data analysis strategy for the reported study.

Personal experience of mixed methods data analysis in the reported study is illustrated in Figure 2. Starting from the data collection phase using a pilot tested instrument where data was collected and reconfirmed for accuracy, the distinct stages of the process are shown.

The initial analysis phase consisted of data preparation and cleaning which was then followed by exploratory data analysis, required for familiarity with the dataset. Data reduction involved principal component analyses tests where the primary attitudes were identified through the use of SPSS. From these, initial deductions of how mobile phones impact social and economic aspects were formed, as attitudes revealed perceptions and uses expressed by the end users. This is shown as the data transformation stage of the quantitative strand (single data type).

The next stage involved juxtaposition of data from both strands, where data were consolidated, correlated or compared depending on the requirements in the following manner. The primary attitudes relating to impact of mobile phones on social issues such as family, tribal or community coherence were consolidated with congruent perceptions from the thematic networks. The identified primary use of mobile phones to maintain contact with family, friends and tribal members was consolidated with similar themes from the qualitative strand.

The case of correlating data was used when the identified primary attitudes were subjected to ANOVA and MANOVA tests to ascertain if there were statistically significant differences between provinces or regions (Figure 3).

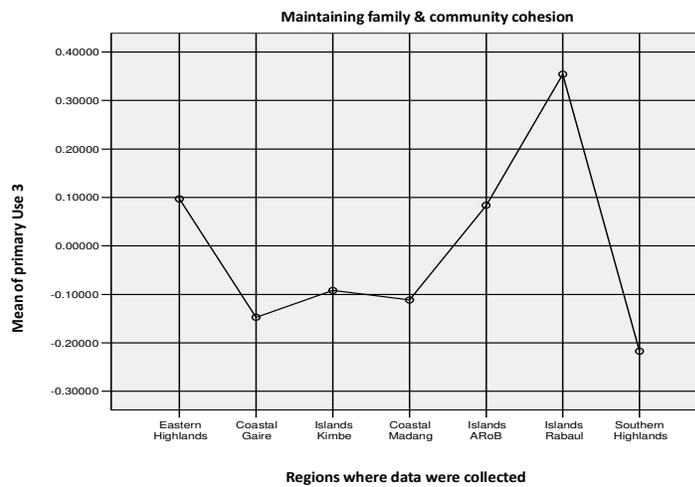


Figure 3: Correlation of primary Use 3 with provinces.

Comparison of primary attitudes with perceptions from thematic networks formed a major element of the analysis process. Comparing and contrasting the primary attitudes from the quantitative strand with perceptions from the thematic networks provided answers to the research questions. The final stage was the careful integration and interpretation for documentation of the study.

Reporting the results

In the study, reporting of results was supported by use of the theoretical framework consisting of DOI and globalization theories. According to DOI theory, the relative advantage, less complexity, compatibility, observe-ability and trial-ability characteristics of mobile phones, led to their permeation across the communities. This was reflected in the identified primary attitudes and uses towards mobile phones, which showed up in direct and indirect connotations to social and economic matters (Table 1).

Table 1: Primary uses of mobile phones in PNG

PCA No	Primary use	Component loading score
1	Business use of mobile phones	0.74
2	Mobile phones as Internet portal	0.78
3	Maintaining contact with family, friends and <i>Wantoks</i>	0.74
4	Enable contact with healthcare and school workers	0.72
5	Exchanging call credits between family and friends	0.77

Source: Suwamaru, 2013

Juxtaposing the above five principal component analyses (PCA) components with the thematic categories of figure 4, it can be seen that PCA components 3 and 5 concur with the themes on social aspects. However, the themes on figure 4 show detailed nuances in comparison to PCA components 3 and 5. Similarly, comparison of PCA component 1 from table 1 with themes from figure 5, clearly show that the thematic networks on business aspects are more elaborate. Comparisons of PCA components from the quantitative strand and thematic networks encompassing qualitative data such as these, illustrate the beauty of deploying mixed method research. Greater illumination was achieved and personally, this was a satisfying experience.

Insofar as globalization theory is concerned, proliferation of mobile phones across the world is resultant of standardization in technology (Manivannan, 2008). Advances in standardisation enable interoperability and compatibility of ICTs. This increases the connectivity within and between nations, enabling the flow of information across spatial and temporal boundaries instantaneous. In the reported study, globalization of mobile phones resulted in more PNG citizens being connected, enabling exchange of information and knowledge within and between distant geographical locations. The increased digital connectivity has impacted on social and economic aspects leading to changes within the communities in PNG.

Reading the primary attitudes toward and uses of mobile phones, complemented by the thematic networks through the theoretical framework, illuminated research questions. Comparing and consolidating the data, it can be asserted that mobile phones can support the widely participatory process of social and material advancement for end users in PNG. The thematic networks concerning social aspects are delineated in Figure 4. They fall under three categories namely access to services, media, and instant contact. Under 'instant contact', Aisi and Algako refer to the practice of yodelling from ridge to ridge in parts of the Highlands region. This practice is slowly being replaced by mobile phones. Themes were triangulated with the primary attitudes from the quantitative strand for improved illumination concerning impact of mobile phones on social aspects.

While there are benefits of mobile phones to the communities, unintended adverse effects were also observed. These were noted as influences on language and culture. Notwithstanding what Roger (2003) claims as negative aspects of an innovation's resistance to its diffusion within a social system, mobile phones tended to be widely diffused regardless of the noted detriments.

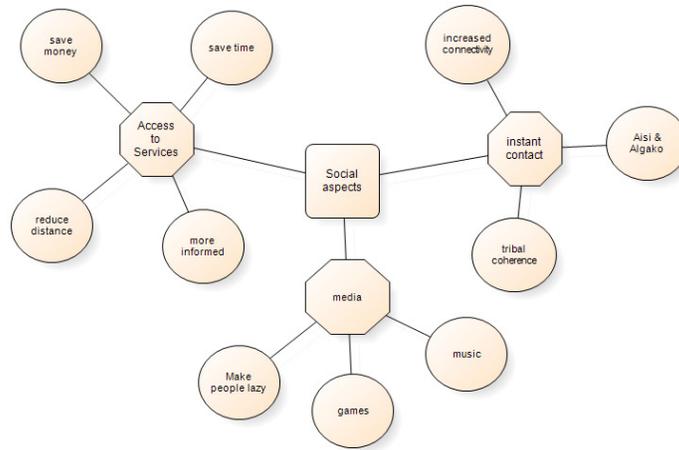


Figure 4: Thematic network for social aspects of mobile phone usage.

Business use of mobile phones featured significantly across both strands of data. In the quantitative data, identified attitudes manifested business uses of mobile phones, while the thematic networks from the qualitative data also concurred as shown in Figure 5.

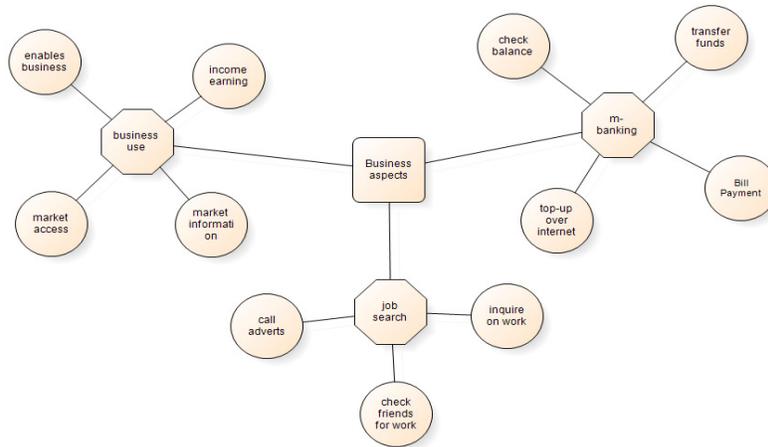


Figure 5: Thematic network on business aspects of mobile phone usage.

Three main categories included business use, m-banking and job search through mobile phones. Again these aspects were triangulated with the identified primary attitudes from the quantitative strand. This process proved invaluable where themes from the qualitative strand added greater illumination to the principal component analyses components from the quantitative strand. The beauty of mixed methods research was again clearly evident from the triangulation of both strands.

Answering the research questions

Research is important in the PNG context to generate knowledge, solutions and change to issues facing the country (Winduo, 2013). For the reported study regarding the impact of mobile phones on socio-economic development, the use of mixed methods research provided an invaluable methodology to find answers to the research questions. The preference of the concurrent mixed methods was because it provided greater enlightenment than if only a single method was used.

Mixed methods research provided confidence from conception to design and implementation so that the collected data are analysed and interpreted to complete the inquiry. Supported by the theoretical framework, the primary attitudes and the themes showed that relative advantage, compatibility, less complexity, observe-ability and trial-ability of mobile phones led to people adopting and using mobile phones for their intended purposes. The regression tests showed factors such as business uses including maintaining contact with healthcare and school systems within PNG communities. Thematic networks offered better illumination and covered wide ranging themes such as social uses of mobile phones in maintaining family and tribal communities contact across temporal and spatial boundaries. Globalization of mobile phones have been aided by advances in standardisation which enables device compatibility and interoperability (Manivannan, 2008). Where citizens adopted and used mobile phones, the increased digital connectivity within and between communities, enabled the flow of information, ideas and knowledge with regard to the things people have reason to value. This reflects globalization. Hence the globalization of mobile phones resulted in people being increasingly connected, which then increased interactivity among them, facilitating increased communications.

Conclusions

This article discussed the use of mixed methods research from personal experience in PNG. Research initiatives in PNG have more room for improvement when compared to other countries. This situation needs recognition and action by academic, private and public institutions. Mixed methods research is particularly invaluable and can provide researchers the tools through which credibility and trustworthiness can be achieved. Research and development are intertwined. Mixed methods research can also offer confidence to both beginning and seasoned researchers because through triangulation and corroboration of quantitative and qualitative strands, increased enlightenment may be attained.

At graduate level studies, mixed methods research can be a rewarding experience with the support of relevant philosophical paradigms and theoretical frameworks. Together, fruitful knowledge creation for the intended research questions can be realized. Mixed methods research can present multiple data which can be consolidated, compared and contrasted, or correlated for enhanced construction of meaning. The experiences reported in this article also provided a flow chart showing how data analyses was undertaken using mixed methods

research in the reported study. This picture is incomplete but can be improved with time.

Research questions were mostly quantitative while thematic networks from the qualitative strand enhanced construction of meanings. This exemplified the beauty of mixed methods research and improved answers to the research questions. Towards this end, mixed methods research is a highly recommendable methodology for enhanced illumination of subjects under investigation.

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