Design and Development of Mobile Application Using Android Studio Software for Learning the Course Research Methodology Effectively - $STTP_{MA}RM$

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***Abstract*: There is a rapid adoption of mobile technology in teaching-learning process of education system. Now a day, the teaching-learning process benefits greatly from the mobile application which makes the learning easy. Students/ learners can go through the contents of the app at their own pace and actively engaged in joyous learning process. Keeping this view in mind, an android mobile application RM (Research Methodology) is developed using Android Studio. This course is important for all students who are doing their graduation, post-graduation and doctorate in any stream such as Engineering, Science, Commerce, Arts, etc. In this research article, new instructional strategy called $STTP_{MA}RM$ (Short Term Training Programme using Mobile Application for Research Methodology) is considered for research scholars of university. A Short Term Training Programme (STTP) titled 'Research Methodology', and sponsored by ISTE (Indian Society for Technical Education) was organised in the college for research scholars for the course Research Methodology as a part of PhD coursework. PowerPoint presentation for each unit of this course available in this app was used during this STTP and Research Methodology (RM) app was given offline to the research scholar for revising the content covered on the particular day of the STTP.**

In current study, the contents of this app and students' perception about this app are provided. Also this app was used on sample of 42 research scholars to check the effectiveness of this app. Test was conducted after each unit content as well as final test covering all units of this course. From the feedback about this mobile app, it is found that 100% students like the concept of using mobile app for learning the course Research Methodology.

***Keywords*: RM, Research Methodology, Android Mobile Application, Quiz, Likert's scale, Feedback**

***ICTIEE* Track*:* Pedagogy of Teaching and Learning**

ICTIEE Sub-Track: Design-based research methodology for pedagogical interventions in learning

I. INTRODUCTION

Learning is a continuous process and the focus is changed from traditional teaching to e-learning. Mobile apps are used for remote learning, exam preparation, creative learning, collaborative projects and assignments, etc. Students/ learners can lean anytime and anywhere at their own pace. These apps encourage students' engagement.

In the current study, newly designed instructional strategy named $STTP_{MA}RM$ (**S**hort **T**erm **T**raining **P**rogramme using **M**obile **A**pplication for **R**esearch **M**ethodology) is considered for research scholars of PhD course. In this strategy $STTP_{MA}RM$, first STTP was conducted in online mode. This Short Term Training Programme (STTP) of Five Days was sponsored by ISTE (Indian Society for Technical Education). Topics/units covered in the STTP related are related to the course Research Methodology such as introduction research and research methodology; formulation of research problem and various methods; various data collection techniques; contents of research reports and how to write thesis; and ethics related to research, intellectual property rights. Mobile Application RM which contains the notes, PPTs, Question bank and quiz for testing the knowledge about this course is used during this STTP and was given to research scholars to revise the content daily during STTP.

So the research question for current study is

- Whether the use of developed android mobile app for the course Research Methodology considered during STTP is useful and helps students to understand the content of this course?

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The learning objectives (LOs) for this study are

- LO1: To describe various steps in literature review process and formulation of a research problem,
- LO2: To describe data collection methods and basic instrumentation,
- LO3: To learn various statistical tools for data analysis,
- LO4: To learn technical writing and communication skills required for research, and
- LO5: To create awareness about intellectual property rights and patents.

Test was conducted on each topic at the end of the each day of STTP. To know about PhD Scholars' perception about this strategy, feedback was conducted on the last day of STTP.

Section 2 discusses the literature survey while section 3 covers the app contents. Sections describe the conclusion and future scope and finally references used while preparing this research article.

II. LITERATURE SURVEY

It is found that the mobile applications are very useful in teaching-learning process for engaging the students.

The author Mehdipour, Y., & Zerehkafi, H. addressed the key areas - mobile learning analysis, difference between e-learning and mobile learning, advantages of mobile learning and disadvantages of Mobile Learning. The author showed that the M-Learning have great benefits to society.

The author (Evrim Baran ; 2014) reviewed 37 articles on mobile learning. This study considered findings as well as the recommendations to the researchers, teacher educators, and policy makers to help for developing research-informed guidelines and theoretical models. These models are used for suggesting mobile learning integration into teacher education. The authors Hingle, M., & Patrick, H. considered the Mobile health (mHealth) which health services and research is affected by mobile and other devices.

The study (Gangaiamaran, R., & Pasupathi, M.; 2017) classify the apps as top-down, bottom-up and interactive models for assisting the learner of different category to choose the appropriate mobile app. The authors Dol, S. M.,et.al. used the various educational game such as crosswords, word matching and word scramble for the course System Programming along with PowerPoint presentation, study Notes, Question Bank containing subjective as well as multiple choice questions, Quiz and Handouts. The study (Oyelere, S. S. et.al. ; 2017) used the mobile learning system which include a traditional board game Ayo with the puzzle - Parson's puzzles. This solution results in motivation and engagement of learners during the learning process.

The authors (Darras, K. E., et. al.; 2019) used the mobile app for medical students of the medical stream radiology. For radiologist, this app provides the framework for developing and incorporating mobile apps into teaching.

Also mobile apps are used to educate students and other relevant stakeholders (Montiel, I., et. al.; 2020) while the authors (Alfonte Zapana, R. et.al.; 2020) considered the mobile application based on sensor to teach the course physics to students.

Various other instructional strategies are also used for the course research methodology such as Learning by Doing (Mekonnen, F. D.; 2020); student centred approach (Motjolopane, I.; 2021); flipped learning (Pinos-Vélez, V.et. al. ; 2020); problem based learning (Saeed, M. A., et. al. ; 2021); Evidence-based practice (Ramdani, Y., Kurniati Syam, et. al. ; 2023); Learning in an Online Research Methodology Course (Song, C. E. Et. al. ; 2021); etc.

Online Research Methodology course is also considered by various researchers ((Mustaqim, B., 2022; Song, C., 2023; Kucukaydin, M. A., 2021). Even Mobile based learning is also used for the course Research Methodology (Dewi, I. P., & Adri, M.; 2020). The authors (Dahri, N. A., et.al., 2023) proposed the mobile-based training certification framework to improve teachers' professional development while the authors (Dahri, N. A., et.al., 2021) considered the integration of mobile technology for collaborative learning and providing on-the-job support to teacher educators. In research article (Curran, V., et.al., 2019), the use of Mobile Learning was adopted in Continuing Professional Development by Health and Human Services Professionals.

There is no research which has considered the use of mobile app during the STTP for covering the content of the particular course. Even there is no research for the course Research Methodology which uses mobile app for RM in online STTP. Hence $STTP_{MA}RM$ (**S**hort **T**erm **T**raining **P**rogramme using **M**obile **A**pplication for **R**esearch **M**ethodology) for such course is considered in this study.

III. RM STTP

Indian Society for Technical Education (ISTE) Approved (Vide Letter No.: ISTE/Proceedings/Online STTP-SF-MAH-053/2021-22) One Week Online Short Term Training Programme (STTP)/ Faculty Development Programme (Self Finance) On "Research Methodology" from 25th October 2021 to 29th October 2021 was organized by Department of Computer Science and Engineering, Vision Buldhana Educational and Welfare Society's Pankaj Laddhad Institute of Technology and Management Studies, Buldhana.

The Short Term Training Program/ faculty development program was designed to enhance the learning of the Research Scholars, Students of UG and PG, faculty members. This Program on research methodology aims to enhance the abilities of all participants to carry out research, and write successful research articles, projects, etc. This program also enables participants to enhance technical writing for national/international journal/conferences. Sessions considered are on relevant research topic selection, literature survey, research planning, writing the project proposal and research paper. The main objective of the program is to improve the quality of research among the participants.

Course objectives for this course as well as for conducting STTP given in the syllabus (https://www.sgbau.ac.in/PhDCell/pdf/NotificationNo1312018forthePhDCourseWork.pdf) are:

- To understand the role of research methodology in Engineering/Science/Pharmacy
- To understand literature review process and formulation of a research problem
- To understand data collection methods and basic instrumentation
- To learn various statistical tools for data analysis
- To learn technical writing and communication skills required for research
- To create awareness about intellectual property rights and patents.

All research scholars, Students from UG and PG, faculty members working in Universities, Colleges, Engineering Colleges, Polytechnics and other Institutions of Higher Education were eligible for this STTP. Every participant has to maintain the attendance at least 80% or more. The participants are categorized as ISTE Member and Non ISTE Member. The E-certificate for ISTE Member will be issued from ISTE office New Delhi. At the end of each day, a Quiz/Test based on MCQ for the content covered on a particular day, will be given which is optional. On the completion of STTP/FDP final Quiz/Test will be conducted based on complete curriculum in which at least minimum 60 % passing is required to get the E Certificate and it is mandatory for all.

IV. RM Mobile App

Research Methodology (RM) Units covered in this mobile app are –

1. Introduction to Research
2. Research Problem Formulation and Methods
3. Data collection
4. Research reports and Thesis writing
5. Research Ethics, IPR and Publishing

For every unit of the course Research Methodology, material such as study notes, PowerPoint Presentations (PPT), subjective question bank, multiple choice question bank, etc. is provided. Also to test knowledge about this course, the quiz is given.

RM app contents are given in the figure 1.

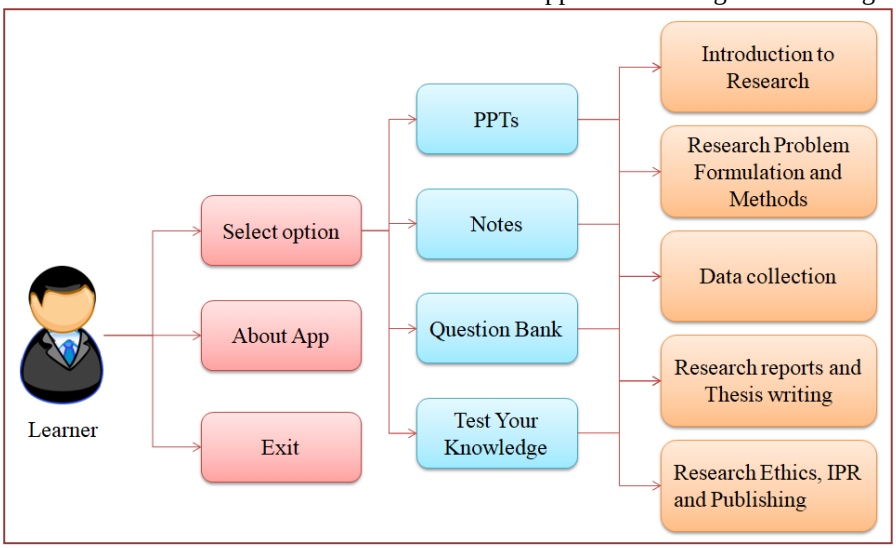

Fig. 1. RM Mobile Application Content

A. *Android SDK for Creation of RM App*

This RM mobile app is created using Android Software Development Kit (SDK) platform. Self created icons are used to denote the PPT, Notes, Question Bank, Test Your Knowledge, About App and Exit. Various color combinations are used while designing this app so that it will become interactive and attractive to use by learner.

B. *Steps to install RM Application from Google PlayStore*

Steps for using this mobile app

Step1 – The .apk file of this app was given to the students. Following icon will be displayed once this application is installed in the mobile. RM stands for the course Research Methodology.

Fig. 2: Application Icon

Step2 - After clicking on the icon shown in figure 1, following screen is displayed for 10 seconds as shown in Figure 2.

Step3 – After 10 seconds, the screen in Figure 3, will be displayed with icons for PPTs, Study Notes, Question Bank, Test Your Knowledge, App information and Exit to come out of the app.

Step4 – Once the learner click on PPTs, or Notes, or Question Bank or Test Your Knowledge, the screen showing the five unit name of RM course as shown in Figure 4 will be displayed.

Fig. 3. Screen for 20 second

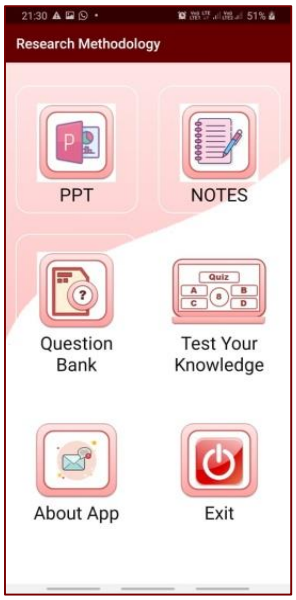

Fig. 4. The main screen of the RM Application

Sample Java code and xml code for Figure 3 screen is shown below-

```
public class Home extends AppCompatActivity {
   ImageView imageView1;
   ImageView imageView2;
   int list[]={R.drawable.backgroundhome,R.drawable.image5};
   String names[]={"hii","bye"};
   GridView gridView;
   @Override
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.activity_home);
      gridView=findViewById(R.id.gridviewhome);
      ArrayList<homedesign> homedesignArrayAdapter=new ArrayList<homedesign>();
      homedesignArrayAdapter.add(new homedesign("PPTs",R.drawable.ppt));
      homedesignArrayAdapter.add(new homedesign("Notes",R.drawable.notes1));
      homedesignArrayAdapter.add(new homedesign("Question Bank",R.drawable.questionbank));
      homedesignArrayAdapter.add(new homedesign
            ("Test Your Knowledge",R.drawable.testyourknowledge));
      homedesignArrayAdapter.add(new homedesign("About App",R.drawable.aboutus));
      homedesignArrayAdapter.add(new homedesign("Exit",R.drawable.exit1));
      homeimages homeimages1=new homeimages(this,homedesignArrayAdapter);
      gridView.setAdapter(homeimages1);
      gridView.setOnItemClickListener(new AdapterView.OnItemClickListener() {
         @Override
         public void onItemClick(AdapterView<?> parent, View view, int position, long id) {
               String activity_name=null;
               Toast.makeText(getApplicationContext(),""+position,Toast.LENGTH_SHORT).show();
               if(position==0){
                  activity_name="RM PPT";
                  Intent intent=new Intent(getApplicationContext(),RMppt.class);
                  startActivity(intent);
               }
            if(position==1){
               Intent intent=new Intent(getApplicationContext(),RMNotes.class);
               startActivity(intent);
            }
            if(position==2){
               Intent intent=new Intent(getApplicationContext(),QuestionbankType.class);
               startActivity(intent);
            }
            if(position==3){
               Intent intent=new Intent(getApplicationContext(),QuizTest.class);
               startActivity(intent);
            }
            if(position==4){
               Intent intent=new Intent(getApplicationContext(),Pdfview.class);
               intent.putExtra("value","aboutapp.pdf");
               startActivity(intent);
            }
             if(position==5){
               finish();
               java.lang.System.exit(0);
            }
         }
      });
   }
}
```

```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
   xmlns:android="http://schemas.android.com/apk/res/android"
   xmlns:app="http://schemas.android.com/apk/res-auto"
   xmlns:tools="http://schemas.android.com/tools"
   android:layout_width="match_parent"
   android:layout_height="match_parent"
   android:animateLayoutChanges="true"
   android:background="@drawable/background1"
   tools:context=".Home">
   <GridView
      android:id="@+id/gridviewhome"
      android:layout_width="381dp"
      android:layout_height="659dp"
      android:layout_marginTop="33dp"
      android:elevation="1dp"
      android:horizontalSpacing="30dp"
      android:numColumns="2"
      android:verticalSpacing="30dp"
      app:layout_constraintEnd_toEndOf="parent"
      app:layout_constraintHorizontal_bias="0.5"
      app:layout_constraintStart_toStartOf="parent"
      app:layout_constraintTop_toTopOf="parent"
      tools:ignore="MissingConstraints" />
</androidx.constraintlayout.widget.ConstraintLayout>
```

C. RM Content

1) Power Point Presentations

Power point presentation for each unit of this course is added in this application. Each PowerPoint presentation has the same format and contains

- First slide about unit name
- Learning outcomes after going through this presentation
- Topics to be covered
- Contents of unit
- References used for preparing this presentation

These PPTs are self-created and same formatting is used for unit name on first slide, title on each slide, text size for content of unit, etc. The sample PPT in app is shown in figure 6 for unit number 4 - Research reports and Thesis writing. The steps used to go through the PPTs are shown in figure 7.

Fig. 5. Units of RM course

Fig. 6. PPTs

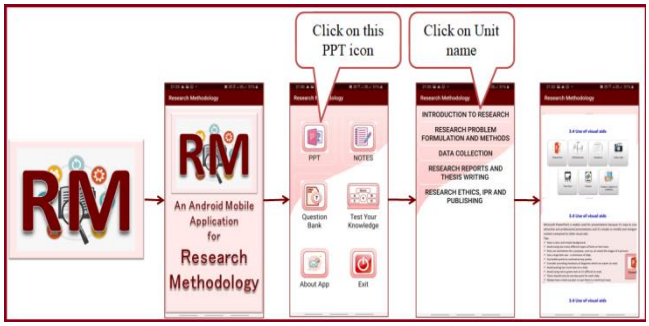

Fig. 7. Steps to go through the PPTs

The sample code xml code and Java code for creating the Figure 5 screen is given below

```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
xmlns:android="http://schemas.android.com/apk/res/android"
   xmlns:app="http://schemas.android.com/apk/res-auto"
   xmlns:tools="http://schemas.android.com/tools"
   android:layout_width="match_parent"
   android:layout_height="match_parent"
   android:background="@drawable/background1"
   android:animateLayoutChanges="true"
   tools:context=".RMppt“>
   <LinearLayout
      android:layout_width="402dp"
      android:layout_height="703dp"
      android:layout_marginTop="4dp"
      android:orientation="vertical"
      app:layout_constraintEnd_toEndOf="parent"
      app:layout_constraintHorizontal_bias="0.5"
      app:layout_constraintStart_toStartOf="parent"
      app:layout_constraintTop_toTopOf="parent“>
      <Button
         android:id="@+id/button1"
         android:layout_width="match_parent"
         android:layout_height="wrap_content"
         android:background="@drawable/outline"
         android:onClick="onclick"
         android:text="Unit I - Introduction to Research"
         android:textAllCaps="false"
         android:textColor="#090909"
         android:textSize="24sp" />
      …..
      <Button
         android:id="@+id/button5"
         android:layout_width="match_parent"
         android:layout_height="wrap_content"
         android:background="@drawable/outline"
         android:onClick="onclick"
         android:text="Unit V - Research Ethics, IPR and Publishing "
         android:textAllCaps="false"
         android:textColor="#090909"
         android:textSize="24sp" />
   </LinearLayout>
</androidx.constraintlayout.widget.ConstraintLayout>
```

```
public class RMppt extends AppCompatActivity {
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.activity_rmppt);
   }
   public void onclick(View view){
      String pptname="";
      switch (view.getId()){
         case R.id.button1:{
            pptname="PPTUnit-I.pdf";
            break;
         }
         case R.id.button2:{
            pptname="PPTUnit-II.pdf";
            break;
         }
         case R.id.button3:{
            pptname="PPTUnit-III.pdf";
            break;
         }
         case R.id.button4:{
            pptname="PPTUnit-IV.pdf";
            break;
         }
         case R.id.button5:{
            pptname="PPTUnit-V.pdf";
            break;
         }

      }
      Intent intent=new Intent(getApplicationContext(),NotesActivity.class);
      intent.putExtra("value",pptname);
      startActivity(intent);
}
```

2) Study Notes

Study notes for each unit of this course are provided in this application with the same formatting followed for each unit. Self-created notes of each unit contain references used for preparing the notes at the end so that learner can go through these links for additional information. The sample notes page is shown figure 9. These notes are made effective by adding the different colours for heading, subheading and adding the useful diagram whenever required. The steps used to go through the notes of each unit are shown in figure 8.

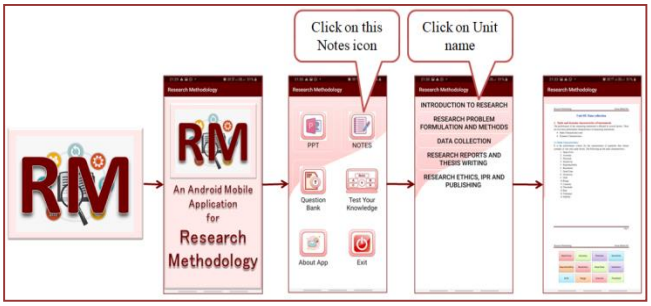

Fig. 8. Steps to go through the Notes

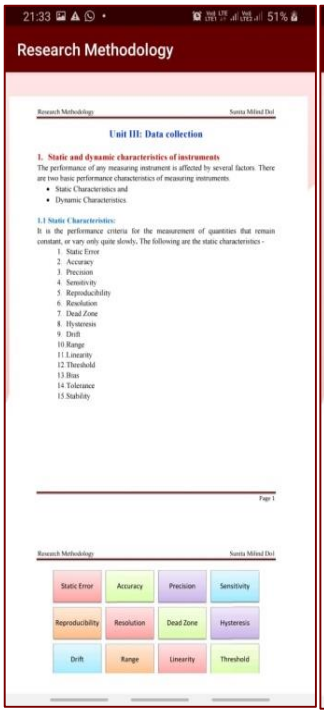

Fig. 9. PPTs

Fig. 10. Question bank

3) Question Bank

This application contains the subjective question bank for every unit of RM. With the help of this question bank, students/ learners will be able to assess their understanding of each unit and learn about potential questions. The question page for Unit-II in RM app is shown in Fig. 10.
The steps to go through the question bank are shown in following figure 11.

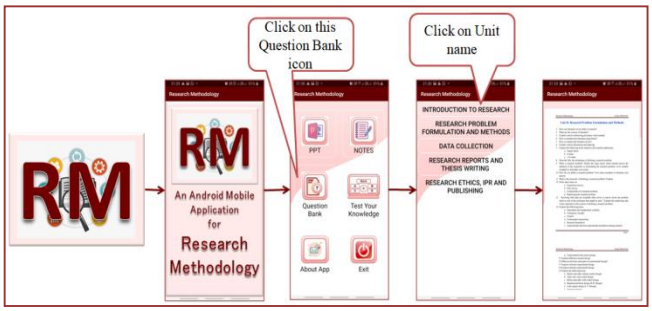

Fig. 11. Steps to go through the Question Bank

4) Test Your Knowledge for each unit

This RM mobile application contains the 'Test your Knowledge' which is nothing but the quiz. Such type of quiz helps the learner to revise the content of each unit. This sample quiz page as shown in Figure 12. Each quiz shows

the

- Number of questions remaining
- The question and
- Options
- NEXT button

The purpose of adding the quiz in this app is to test learner's own language.

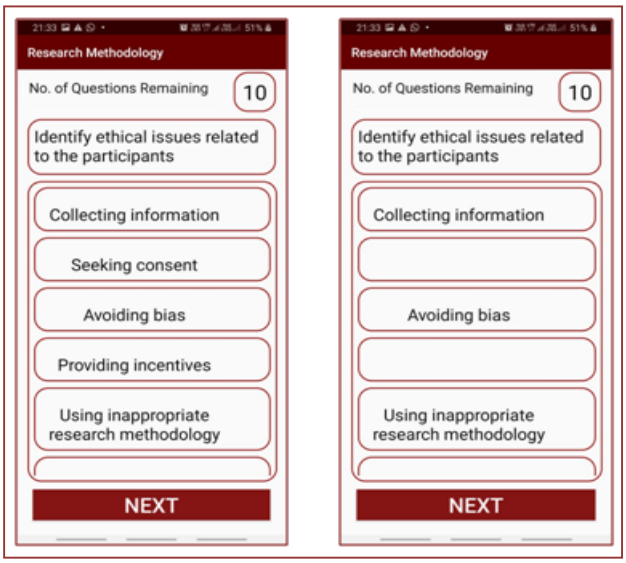

Fig. 12. Test Your Knowledge - Quiz

Steps to attempt the quiz-

- Step 1 - Go through the question
- Step 2 - After reading the question, learner has to click on the options.
- Step 3 - If the checked option/s is/are the correct answer then those options will be removed.
- Step 4 - If all correct options are chosen by learner then only click on the NEXT button for the next question
- Step 5 - If the learner click on the NEXT button before attempting the all correct options, the displayed message will be– "Still some correct options are there"

To attempt other questions of the same unit, above steps 1to 5 are followed.

Number of questions considered for each unit is given in table1.

TABLE I
NUMBER OF QUESTIONS IN QUIZ

Sr. No.	Unit name	Number of question
1	Unit-I : Introduction to Research	6
2	Unit-II : Research Problem Formulation and Methods	11
3	Unit-III : Data Collection	21
4	Unit-IV : Research Reports and Thesis Writing	13
5	Unit-V : Research Ethics, IPR and Publishing	11

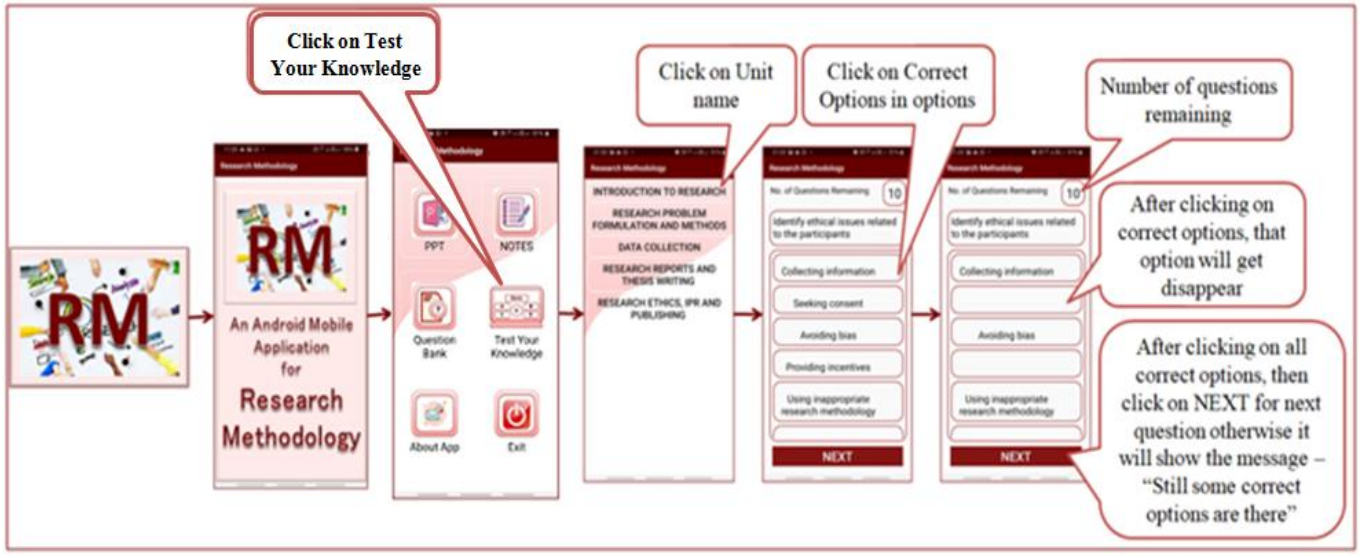

Fig. 13. Steps to attempt Test Your Knowledge

5) About app

Information about the app is provided in 'About app' option. The App information contains -

- Units covered in the App
- Course objectives of this course RM
- Syllabus of RM
- How to use this app
- References for creating the material of this app.

The information about the app displayed in RM app is shown in Figure 14.

Sample code for viewing the "About App" part of this app is given below.

```
public class Pdfview extends AppCompatActivity {
PDFView pdfview;
String pdfname="";
   @Override
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.activity_pdfview);
      Intent intent=getIntent();
      pdfname=intent.getStringExtra("value");
      Toast.makeText(getApplicationContext(), ""+
               pdfname, Toast.LENGTH_SHORT).show();
      pdfview=findViewById(R.id.pdfview1);
      pdfview.fromAsset("PPT/"+pdfname).defaultPage(0).load();
   }
}
```

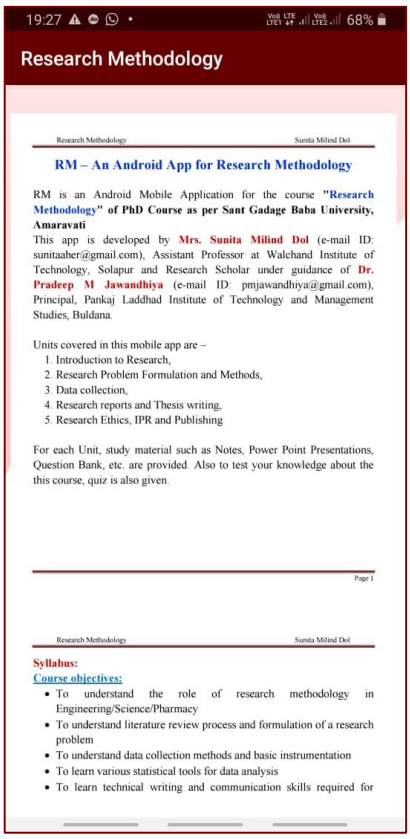

Fig. 14. About App

The steps to go through this 'About App' are given in Figure 15.

Fig. 15. Steps to go through About App

V. RESEARCH DESIGN AND FEEDBACK

A. Experimental Details

The experimental details for the instructional strategy $STTP_{MA}RM$ are given in the Table II. Sample use for this strategy is a group of 42 research scholars from Sant Gadage Baba Amaravati University while method used is single group post-test method. Instruments used to check the effectiveness of this strategy on PhD scholar are

- post-test questions containing Bloom's Taxonomy - Cognitive Domain-Recall, Understand, and Apply Level and
- Survey questionnaire and feedback from open ended questions

Learning domain used is Bloom's Taxonomy and t-Test is used as a statistical analysis tool to check significant improvement in the performance of students.

TABLE II
EXPERIMENTAL DETAILS

Instructional Strategy used	$STTP_{MA}RM$
Sample	A group of 42 research scholars from Sant Gadage Baba Amaravati University
Method	Single group post-test model
Instruments used	• Post-test • Survey questionnaire and feedback from open ended questions
Learning Domain used	• Bloom's Taxonomy • Cognitive Domain-Recall, Understand, and Apply Level
Statistical analysis	t-Test

The learning objectives for this study are

- LO1: To describe various steps in literature review process and formulation of a research problem,
- LO2: To describe data collection methods and basic instrumentation,
- LO3: To learn various statistical tools for data analysis,
- LO4: To learn technical writing and communication skills required for research, and
- LO5: To create awareness about intellectual property rights and patents.

The research question for current study is

- "Whether the use of developed android mobile app for the course Research Methodology considered during STTP is useful and helps students to understand the content of this course?"

B. Research Design

Figure 16 shows the research design for conducting the activity. First RM App for the course Research Methodology is prepared. After preparing this app, all research scholars taken admission to PhD course were given the app's .apk file to install in the mobile. The STTP on Research Methodology was conducted and this app was used by research scholar during this workshop period.

Following steps are considered for five days of STTP:

- Speaker taught the particular unit on particular day of STTP with the help of the PPT which are available in RM mobile app, in Morning and Afternoon session.
- After covering the content of particular unit on particular day, one hour was given to research scholars after afternoon session to revise the PPT of respective unit.
- After revising the content of particular unit, test is conducted on that particular unit of that particular day of STTP.

Final test covering all units of Research Methodology was covered on the last day of STTP. After all test, statistical analysis of all test results are performed with the help of statistical analysis tool: t-Test.

Detailed Day 1 to Day 5 session contents and activities which cover Unit-I to Unit-V respectively are explained below

- Day 1 of STTP: On Day 1 of this STTP, various topics of Unit-I Introduction to Research such as

1. Definition of research,
2. Characteristics of research,
3. Types of research-
4. Research approaches
5. Research process
6. Overview of research methodology in various area
7. Introduction to problem solving
8. Basic research terminology such as proof, hypothesis, lemma etc.
9. Role of Information and Communication Technology (ICT) in research

are covered in morning an afternoon session with the help of PPT provided to the speaker.

- Day 2 of STTP: Contents of Unit-II Research Problem Formulation and Methods such as

1. Literature review,
2. Sources of literature,
3. Various referencing procedures,
4. Maintain literature data using Endnote2,
5. Identifying the research areas from the literature review and research database,
6. Defining the research problem,
7. Determining the scope, objectives, limitations and or assumptions of the identified research problem and
8. Research design

are covered with the help of PPT by speaker for that day.

- Day 3 of STTP: Following topics covered for Unit-III : Data collection are with the help of PPT by the speaker of that day.

1. Static and dynamic characteristics of instruments,
2. calibration of various instruments,
3. Sampling methods,
4. Methods of data collection,
5. Basic Concepts concerning testing of hypotheses,
6. Applied statistics
7. Software tools for modelling, Simulation and analysis.

- Day 4 of STTP: Mainly three topics of Unit-IV: Research reports and Thesis writing were covered in fourth day of STTP with the help of PPT provided to the Speaker. These topics are

1. Introduction: Structure and components of scientific reports, types of report, developing research proposal.
2. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes,
3. Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication

- Day 5 of STTP: Day 5 of STTP considered Unit-V: Research Ethics, IPR and Publishing and various topics covered under this unit are

1. Ethics: Ethical issues.
2. IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights
3. Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

C. Feedback

Research scholars' opinions of this RM mobile app are determined by using five values using Likert's scale in feedback questions: strongly disagree (SD), disagree (D), neutral (N), agree (A), and strongly agree (SA). The feedback is shown in Table III.

TABLE III
FEEDBACK FORM

Sr. No.		SA	A	N	D	SD
1	RM app covers the syllabus of Research Methodology Course.	80%	20%	-	-	-
2	The PPTs given in the app is helpful to understand and revise the topics.	82%	18%	-	-	-
3	Course material given in the form of Notes in this app is useful for thoroughly studying various topics.	78%	20%	2%	-	-
4	The question bank containing subjective as well as multiple choice questions given in the app is useful as well as covers the complete units.	57%	43%	-	-	-
5	I tried to attempt and answer all the question given in the quiz part of app.	85%	15%	-	-	-
6	The quiz contained in 'Test Your knowledge' of the app is useful for testing the knowledge about this course.	78%	22%	-	-	-
7	I attempted all questions covered in 'Test Your knowledge'.	90%	10%	-	-	-
8	This RM mobile app makes concepts of the course Research Methodology easy to understand	66%	34%	-	-	-
9	Whether you like this RM mobile app?	Yes = 100%				

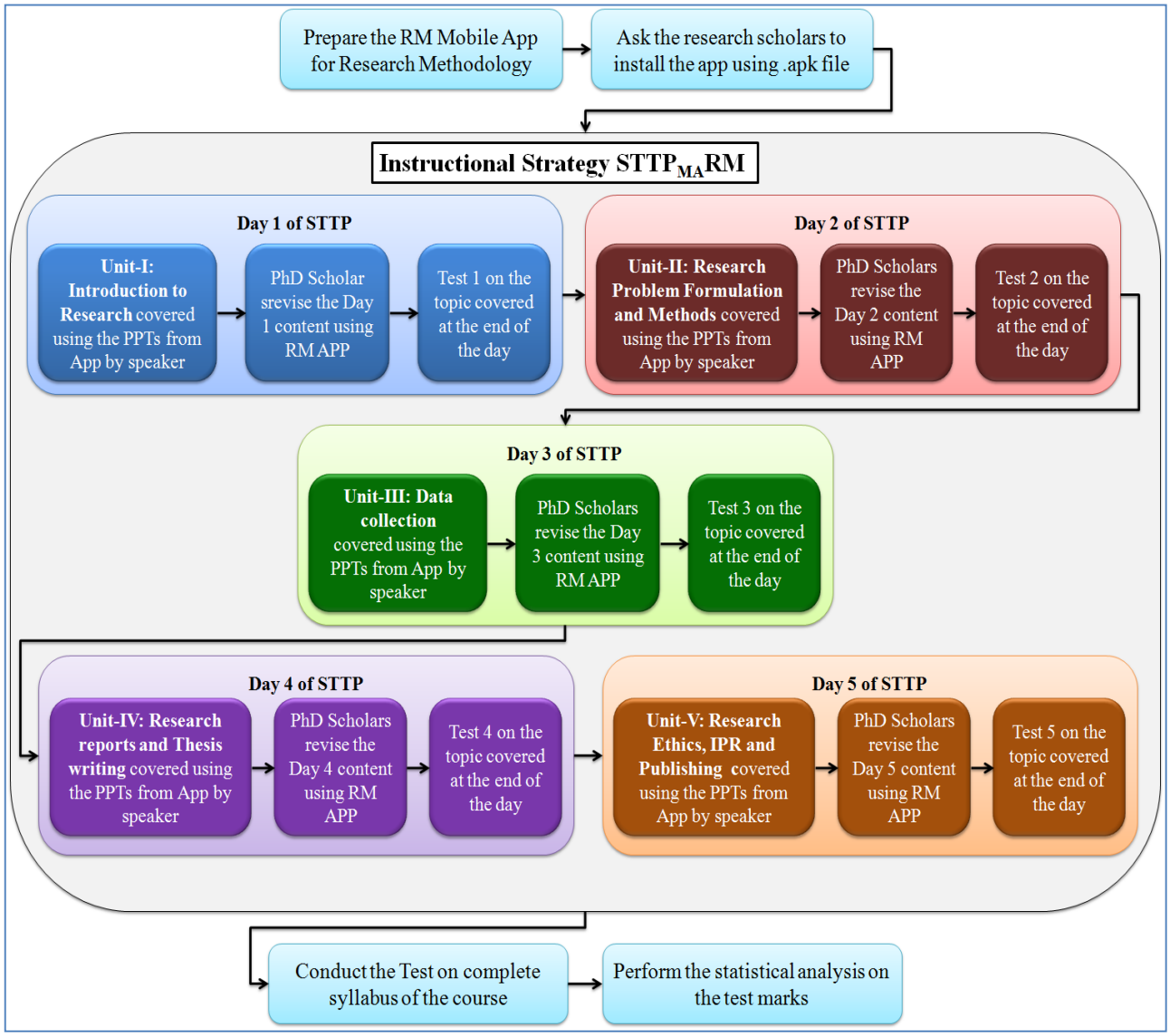

Fig. 16. Research Design

VI. Result Analysis

This app was used on sample of 42 research scholars to check the effectiveness. After covering the content of each unit, the test was conducted for these students. The result of five tests is shown in Figure 16 - 20. Figure 21 shows the result of final test covering all units of Research Methodology course.

A. Unit-wise and Final Test Marks Analysis

Figure 17 shows the Unit-I: Introduction to Research test marks analysis. For this test, population average is 39. This test mostly covers questions of Remember and Understand level of Bloom' Taxonomy.

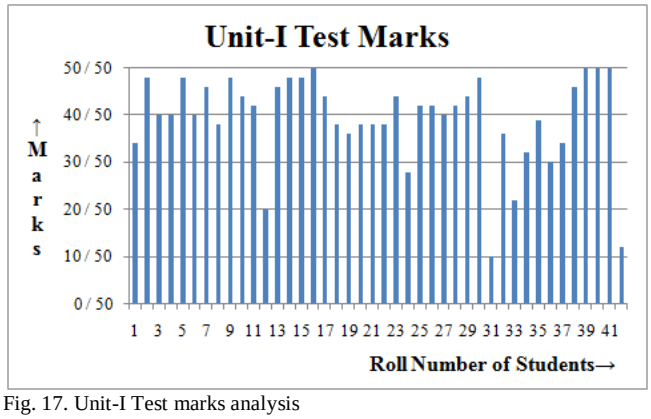

Fig. 17. Unit-I Test marks analysis

Unit-II: Research Problem Formulation and Methods test marks analysis with population mean 35 is shown in Figure 18. The test on this unit covers questions of Understand and Apply level of Bloom' Taxonomy. Test marks analysis with

population mean 36 for Unit-III: Data collection is represented graphically in Figure 19.

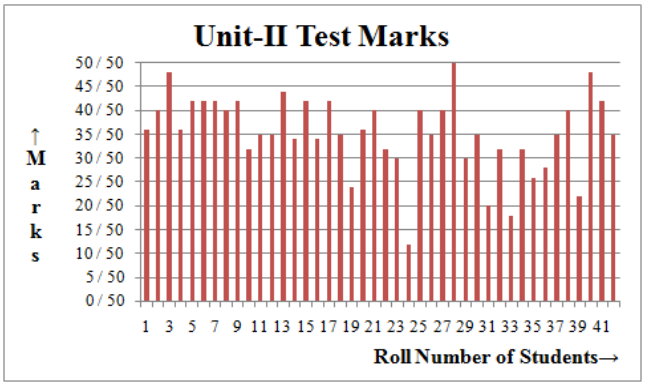

Fig. 18. Unit-II Test marks analysis

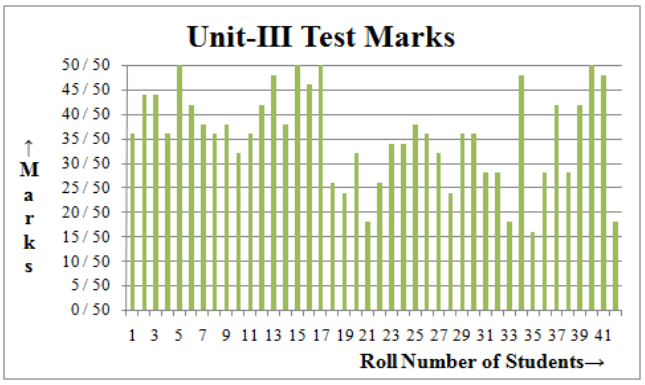

Fig. 19. Unit-III Test marks analysis

Figure 20 indicates the marks obtained by 42 students in the Unit-IV: Research reports and Thesis writing. For this test, population average is 32. This test mostly covers questions of Remember and Understand level of Bloom' Taxonomy.

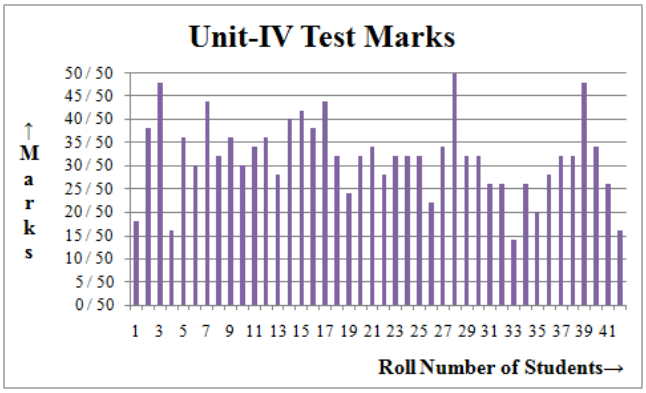

Fig. 20. Unit-IV Test marks analysis

The analyses of test marks obtained by 42 students with population mean 33 in the Unit-V: Research Ethics, IPR and Publishing is shown in Figure 21. This test mostly covers questions of Remember and Understand level of Bloom' Taxonomy.

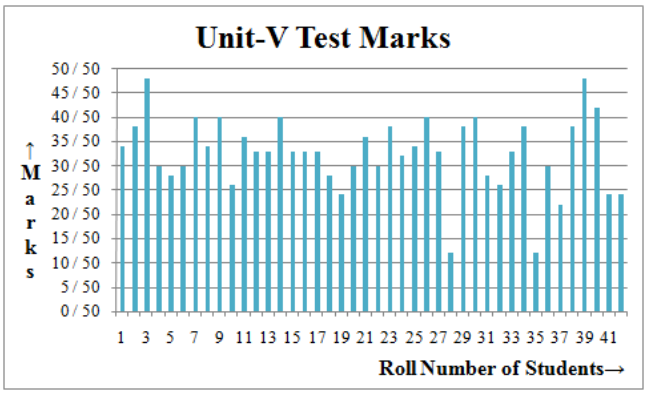

Fig. 21. Unit-V Test marks analysis

Figure 22 shows the test marks analysis of final test covering all units of the course Research Methodology. For this test, population average is 76. This test is considered for 120 marks. This test mostly covers questions of Remember, Understand and Apply level of Bloom' Taxonomy.

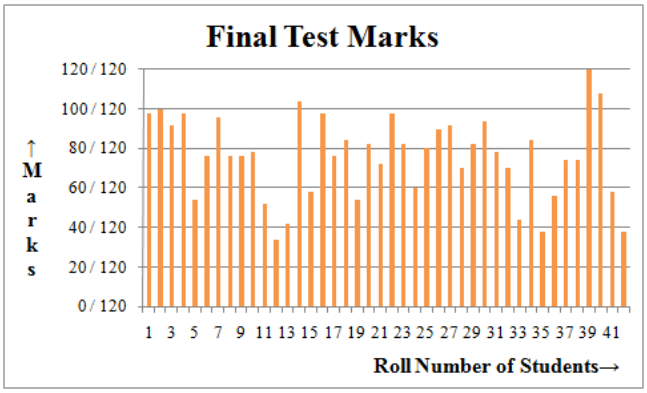

Fig. 22. Final Test marks analysis

B. Statistical Analysis using t-Test

The mean of a single sample score is compared to a known population mean using a Single Sample t-test. In this method, input is the value of known (or hypothetical) mean and sample scores.

A Single Sample t-test contains mainly two values – p-value and t-value. The estimated difference between two group averages in relation to the variability within the groups is known as the "t-value" in statistical analysis using the t-test, and it indicates how significant the observed difference is. This value must be large value as compared to the critical value which is usually 0.05. Based on a selected significance level, the "p-value"—the likelihood of finding such a difference if there was actually no difference between the groups—helps decide whether to reject the null hypothesis. This p-value must be less than 0.05 for the significant result.

In statistical analysis, t-value and p-values are obtained using t-test statistical analysis method which is performed online (link - https://www.socscistatistics.com/tests/tsinglesample/default2.aspx).

From Table 3, hypothesis of this study is: There is significant difference in mean score between sample and overall population means as it is observed that p-value (probability) is less than 0.05.

TABLE IV
STATISTICAL ANALYSIS

Test	Population Mean	t-value	p-value
Test1 (50)	39	0.241	0.0406
Test2 (50)	35	0.248	0.0403
Test3 (50)	36	0.257	0.0399
Test4 (50)	32	0.183	0.0428
Test5 (50)	33	0.344	0.0366
Final Test	76	0.487	0.0294

C. Research Question and Hypothesis of the Study

The research question for current study is

"Whether the use of developed android mobile app for the course Research Methodology considered during STTP is useful and helps students to understand the content of this course?"

Hypothesis of our study are -

H1: Students' test score shows the significant improvement as the p-value for Unit-I test marks using statistical analysis single group t-Test is 0.0406 which is less than 0.05.

H2: Students' test score shows the significant improvement as the p-value for Unit-II test marks using statistical analysis single group t-Test is 0.0403 which is less than 0.05.

H3: Students' test score shows the significant improvement as the p-value for Unit-III test marks using statistical analysis single group t-Test is 0.0399 which is less than 0.05.

H4: Students' test score shows the significant improvement as the p-value for Unit-IV test marks using statistical analysis single group t-Test is 0.0428 which is less than 0.05.

H5: Students' test score shows the significant improvement as the p-value for Unit-V test marks using statistical analysis single group t-Test is 0.0366 which is less than 0.05.

From above hypothesis, we can say that the use of developed android RM mobile app considered during STTP is useful and makes easy for students to understand the content of this course.

D. Limitations of the Study

Limitations of this study are –

- Suggestions from Research scholars after going through this RM app-

There should be the mechanism to revise the content of this course.

The unit-wise quiz covering the whole syllabus of the course Research Methodology should be given for practice purpose.

- Sample Size - Number of research scholars attended this STTP is 50 but not all research scholars has given all tests and final test. So for this study, only data of only those research scholars are considered who have given all tests and final test. Hence the sample size considered is 42 research scholars only. It can be increased.
- Potential Technical Issues – This RM app is only for Android and not for iOS mobile operating system. For the app to be worked with the iOS mobile operating system, this app should be developed on the Flutter - an open source framework.
- User Adaptability - The app should contain the user interface which will tell the user about the steps to go through content of this app.

CONCLUSIONS AND FUTURE WORK

In this study, new instructional strategy titled as $STTP_{MA}RM$ (Short Term Training Programme using Mobile Application for Research Methodology) is considered. In this strategy, the developed RM mobile app for the important course Research Methodology is used during the STTP sponsored by ISTE. Even PPT used in this app for each unit is given to speakers for covering content of that particular unit. The RM mobile app for this course – Research Methodology which can be used by undergraduate students, postgraduate students and research scholar is also considered during this instructional strategy. This app contains the self-created notes, PPTs, question bank and quiz to test your knowledge. The research question for this study is

- "Whether the use of developed android mobile app for the course Research Methodology considered during STTP is useful and helps students to understand the content of this course?"

With the help of statistical analysis, it is observed that this strategy is useful for the course Research Methodology. Even from students' feedback about RM app, it is found that research scholars like this RM app used during this STTP.

In future, the various content such as multiple choice questions or content to revise this course can be added to this app. Even steps to go through the content of the app can be considered while developing the mobile app. If the study material such as Notes, PPTs, Question Bank, etc. is created for any course then the app for such course can be developed. Instead of Android platform, if the Flutter – an open source platform is considered for developing the app then that app can be used by Android as iOS mobile users.

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