INDIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ORIGINAL ARTICLE

OPEN ACCESS

Received: 23/03/2025

Accepted: 09/04/2025

Published: 29/06/2025

Citation: Yadufashije C, Uwilingimana C, Muhimpundu L, Twagirumukiza G, Gikunju J (2025) Mathematical Equation Could Be a Tool of Teaching and Learning the Basics of Research Methodology: Theory. Indian Journal of Science and Technology 18(24): 1961-1971. https://doi.org/10.17485/IJST/v18i24.544

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Funding: None

Competing Interests: None

Published By Indian Society for Education and Environment (iSee)

ISSN
Print: 0974-6846
Electronic: 0974-5645

Mathematical Equation Could Be a Tool of Teaching and Learning the Basics of Research Methodology: Theory

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Abstract

Background/objective: Research methodology describes the set of techniques and processes through which a researcher passes to identify and analyze information on a particular research problem. It has been a challenge for novice researchers to understand the research methodology course, which has led to the idea of thinking about new tools to understand it, and mathematical equations could be good tools. **Methods:** The algebraic equation system was written randomly, and its main parts were described and compared on both the equation side and the research side. While doing comparisons, we considered important elements of the research, including the research questions, objectives, variables, hypotheses, conceptual frameworks, research problems, and research methods. All the elements were described and compared on the side of the equation and research. **Findings**: The successful comparison of the elements of the algebraic equation and research helped to provide the similarities of the basic elements of research and that of the equation. Some parts were more similar, while others had some few differences, and it was required to be translated in the language of the research methodology. For example, the coefficients were considered frequencies in the research, whereas the constants from the equations were taken as dependent variables. **Novelty:** The use of the algebraic equation as a tool of teaching and learning research methodology has not been described or studied before; it is an innovative approach that does not require any other application except good analysis. Translational interpretation of equation components to research methodology has been used to explain the key research concepts and this has highlighted the uniqueness of this new methods of teaching research methodology in higher education specifically for scientists.The algebraic equation was demonstrated to be a tool for understanding research methodology, it was discussed on the basis of ideas and explanations. The successful comparison of the parts of the equation in research was the main approach to understand this theory. The use of this new tool to understand the research methodology course is advised.

Keywords: Learning; mathematical equation; research methodology; teaching; tool

1 Introduction

A research methodology is a discipline that explains the methods and processes utilized for identifying and analyzing information on a particular research topic or research problem [1]. The process involves researchers systematically following a specific research design to achieve the objectives of the study through the use of approved research tools [2]. In the research methodology unit, several important elements, including research design, data collection, data analysis, and other elements, were discussed [2]. It is of importance to understand that mathematical equation itself represents a research problem with unknowns for which a clear methodology is needed to obtain the true values of unknown variables [3]. The above aspects could help us understand the meaning of the research methodology, and the scientists need to understand why selecting the true or right research methodology is very important. An appropriate research methodology provides a good framework and guidelines for writing concise research questions, research objectives, and hypotheses [4]. On the other hand, mathematical equations should be analyzed before performing any operation to find the values of unknown variables, and the methods used to find the values of unknown variables depend on the type of equation, number of unknowns, and other different aspects. It is understood how equations are tools for teaching research methodology, and their aspects are similar; for example, the major aim of research is not to gather information on a specific topic but to seek answers to research questions that were not answered by previous research. The aim of a mathematical equation is also to determine values or solutions of unknowns identified in the equation formed [5]. Research methodology involves a set of methods, rules, principles, theories, and values to be applied to achieve a research journey [6]. Like mathematical equations, any method selected to solve the equation has a number of principles and rules to be followed until a solution of the unknown variable is obtained [6]. To highlight here, the research methodology section should focus on the flowchart that the researcher has gone through to collect data and put rights on how they were analyzed, as mathematicians should show how the process of obtaining answers to unknown variables has gone through from beginning to end; they cannot write answers without showing the way through which they have followed to reach them [7]. Understanding research methodology has been an issue for novice researchers until they do not understand how research methodology should be structured in their research paper or thesis, which is why new tools to teach this group are needed and mathematical equations are included [2]. Mathematical equations are made of the two algebraic expressions in which the equal sign is located between them, which shows the relationship between the expressions written on the right side and those written on the left side [8]. In research methodology, this is the first thing that researchers should consider: what is the relationship between what you think is the cause of the problem and the problem itself? The equation aims to solve and determine the values of unknown variables, which is not far from the aim of the research methodology, as per our previous paragraphs. Research methodology has been challenged for scholars in higher education because of the way it is taught with the lack of teaching aids and materials, and this could be evaluated through its application during the final year when students are asked to write their proposals and concepts as requirement for graduation [9]. Lecturers use theoretical teaching methodology than practical teaching which limit the learning capacity of the research methodology course among the students and scholars [10]. This new approach of teaching and learning research methodology, which was thought to be a guiding tool, is one of the tools that will help lecturers and students to really understand what research is in a practical manner, and facilitate the learning process of the course. Grabbing the mind of the students before taking this course using the components of mathematical equations will contribute to the understanding of the course at beginning and this will influence its application in the future. Equation has a number of components that research has and this relationship with clear interpretation is addressed in this theory and could be one of the solutions to put in place for the process of teaching and learning research methodology course.

2 Methodology

2.1 Origin of the idea

Research methodology is a topic of importance in universities and other tertiary intuitions, where it is considered in every program of study in higher learning institutions across the world. The traditional way of teaching research methodology has confused students from undergraduate to postgraduate, and even young fresh PhD holders face the challenge of research methodology depending on the kind of training that they have received during their studies. For this purpose, we wondered how we could contribute to this course to help people understand that research methodology is a part of the old definitions written in a number of books. There is a lack of new approaches to explain the research methodology for participants to understand this subject of importance. We believe that mathematical equations could also be among the good ways and tools used to explain some basics of the research methodology. How could we go through this? In mathematical equations, what we call unknowns, which are also considered variables, from this point, a number of things can be understood. The equation we have considered randomly has unknowns such as (x), (y), and (z), which are variables of interest, and when their values are found, they will be

equal to the constants (l), (m), and (n) located in the second part of the equation. Let us first have a common understanding of this: (x), (y), and (z) are unknowns in the equation, and we need to determine their values; we do not know them, and we apply different methods to obtain their values for the given equation. These are also considered to be the cause of the problem under investigation; they are what we are searching for to solve the problem under investigation, and we also apply different methods to identify the cause of the problem under investigation. Any variable or unknown in the equation system could replace any cause of the problem under investigation in research. The common sense here is that both equation and research methods are searching for unknowns to solve the problem, which is why equations could be good tools for learning and teaching research methodologies, especially in science-based programs. On the other hand, our equation system has (l), (m), and (n) on the right side, which are known as constants in the equation and depend on the values of (x), (y), and (z). For research, we have taken these constants as the dependent variables or effects because they depend on the values of (x), (y), and (z), which are considered independent variables or causes in the research methodology. In the equation again, we have *(a), (b), (c), (d), (-e), and (f)* that multiply our variables (x), (y), and (z), which are known as coefficients in the equation system, and they show the frequencies required for any unknown value. For research, these variables were considered as magnitude, size, extent or level of occurrence for a research variable or cause in the study population. From here, research questions could be formulated, and research objectives could be formulated on the basis of the description provided above. For example, on the side of the equation system, we ask the following question: "what are the values of (x), (y), and (z)? In research, we can ask What are the x-causes of *l, m,* and *n* outcomes or effects in a given population? For the objectives on the side of equation systems, our objective is to determine the values of (*x), (y), and (z);* for research, our objective is to determine the x-causes of l, m, and n outcomes or effects in a given population. Pedagogically, the students will be exposed to the deep discussion of equation and research relationship and active learning will be used to make sure that they understand the tool. As per introduction section, the aim of research is mainly to find answers to research questions that were not answered by previous research, the equation also seeks answers to unknowns or variables indicated to be found out from this background student will understand and capture the course of research methodology. Refer to Table 1 for details.

3 Results and Discussion

3.1 Results

3.1.1. Conceptual framework

In our previous section, (x), (y), and (z) were described as causes or independent variables for research, whereas (l), (m), and (n) were considered effects, outcomes, or dependent variables in research. Thus, in Figure 1, each variable was considered to have a direct relationship with all mentioned independent variables. According to our framework, (x)-causes could have relationships with (l), (m), and (n) outcomes, which may be fully or partially related. The same applies to (y) and (z). To understand this using the equation system, the value of (x) calculated will be the same as that of the whole equation system; they will not be 3 because we have an equation system consisting of 3 equations. (y) can have relationships with (l), (m), and (n) outcomes, and (z) can have relationships with (l), (m), and (n) outcomes. The conceptual framework shows the relationships between variables, which means that here, we have one equation system but with 3 equations; however, since one system consists of 3 equations, the value of one variable will be the same within the system, which is why, in terms of research, one variable will have a direct relationship with all the independent variables in the system. meaning that any individual variable change in (x), (y), or (z) will directly have an effect on all (l), (m), and (n). what does mean? We address the issue of the relationship between variables and directly understand the role of variables in the problem under investigation. These findings highlight the complexity of the problem and how solving it requires much work. Importantly, in this context, in the equation system, we have one value of (x), one value of (y), and one value of (z); however, each value has a relationship with the entire equation system, which leads to the construction of this conceptual framework, where only one variable has 3 arrows that show its relationship with the constants (l), (m), and (n). Another aspect of concern is that each dependent variable is related to all the independent variables at the same time, where (x), (y), and (z) have direct relationships with (l), (x), (y), and (z) have direct relationships with (m), and (x), (y), and (z) have direct relationships with (n). However, the outcomes are not the same in the population in which they are unique or different in the equation system; they are not found twice in the system. An outcome may be aggravated or simple depending on the type of population

3.1.2. Occurrence and distribution of the problem in a given population

In our equation, we have a system of 3 equations. What does this mean or show in research? This may show that a study population in 3 dimensions or a population in different regions may be in a country. For example, we can carry out a study on the prevalence of cervical cancer in a given population. We then divide our population into groups such as women of reproductive

Table 1. Translation of equation elements into research elements

Equation		In Research	
Items	**Description**	**Items**	**Description**
$\begin{cases} x+y+z=l & (1) \\ ax+by+cz=m & (2) \\ dx-ey+fz=n & (3) \end{cases}$	Equation system	$\begin{cases} x+y+z=l & (1) \\ ax+by+cz=m & (2) \\ dx-ey+fz=n & (3) \end{cases}$	For Research, equation system could show the problem, a phenomenon, or a situation under investigation in different population especially when the problem affects the heterogeneous population
(x), (y), and (z)	Unknowns or variables	*(x), (y), and (z)*	Either independent variables, causes or what we are searching for
(a), (b), (c), (d), (e), and (f)	Coefficients	*(a), (b), (c), (d), (e), and (f)*	Magnitudes, size, extent or level of occurrence for a research variable or cause in the study population
(l), (m), and (n)	Constants	*(l), (m), and (n)*	Either dependent variables or effects
Objectives	To determine the value of *(x), (y), and (z)*	*Research Objectives*	• To determine the *x*-causes of *l, m,* and *n* outcomes or effects in a given population • To determine the *y*-causes of *l, m,* and *n* outcomes or effects in a given population • To determine the *z*-causes of *l, m,* and *n* outcomes or effects in a given population
Question	What are the values of *(x), (y), and (z)* in the equation system?	Research question	• What are the *x*-causes of *l, m,* and *n* outcomes or effects in a given population? • What are the *y*-causes of *l, m,* and *n* outcomes or effects in a given population? • What are the *z*-causes of *l, m,* and *n* outcomes or effects in a given population?
Substitution, comparison, Gauss methods etc.	Methods applied to find the value of *(x), (y), and (z)*	Substitution, comparison, Gauss methods etc.	These are like the study designs that are methods applied to respond to the research questions and achieve objectives of the study

age, teenagers, and women undergoing menopause. Our population in three dimensions is represented in the form of **equation (1)**, which can represent women of reproductive age; **equation (2)**, which can represent teenagers; and **equation (3)**, which can represent women undergoing menopause. This can also be represented via equations $x+y+z=l \quad (1)$, which represent women of reproductive age; $ax+by+cz=m \quad (2)$, which represents teenagers; and $dx-ey+fz=n \quad (3)$, which represents women of menopausal age. This is the problem, situation, or phenomenon in populations of different categories in one area. The problem could also occur in 3 regions in a country, that is, a system of 3 equations showing all concerns that we are trying to explain. We remember that we are using the equation system as a tool to explain the basics of the research methodology. Here, we can ask ourselves some questions: will the value of (x) be the same across the 3 categories of the population? The answer is yes, but its size is affected by the coefficients. In terms of research, the number of occurrences of a variable determines the difference in the population. In **equation (1)** of the system, there are no coefficients for all the variables, which shows that their

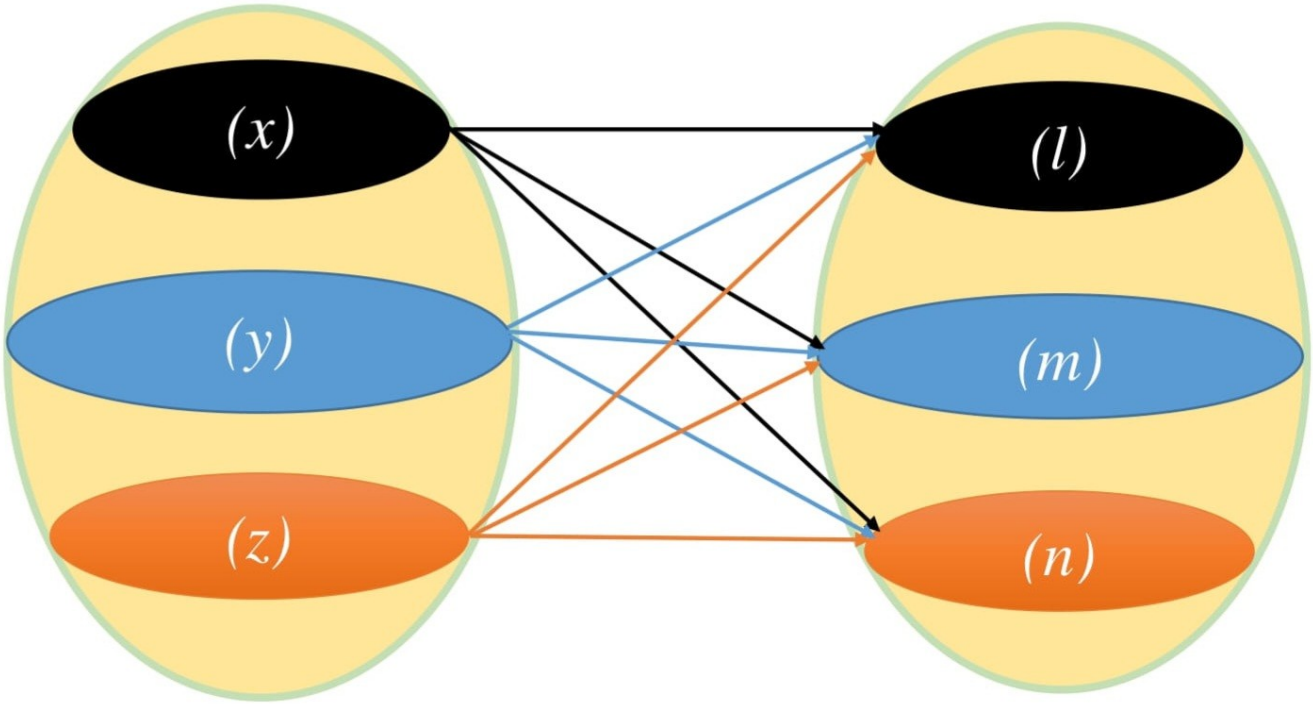

Fig 1. Conceptual framework

occurrence may be shorter in the population than in the others. Here, we can also identify the most affected population, but it may depend on the coefficients since they are different. However, in our system, it is immediately possible to identify the less affected population, which is either population one or population 3. Having an equation system does not mean that one simple equation cannot work, but the equation system considers a problem in a complex population. This means that the equation system may reveal one problem involving a complex population in the region or one problem occurring in different places of a country. There may be 3 equations, 2 equations or 5 equations depending on the population affected and how one wishes to explain the problem, phenomenon or situation under investigation (Figure 2).

3.1.3. Research hypothesis approach from the equation system

Another challenging aspect in research is what we call the hypothesis. Statisticians have tried to explain hypotheses with good scientific support, but in regard to their application, researchers always face challenges, even with respect to these research methods. This small section of the paper does not explain much about hypotheses since a number of books have provided significant meaning; here, we use our equation system to show how mathematical equations help us understand hypotheses. Here, we propose 8 possibilities to test for hypotheses. The first possibility is the case where x=0, y≠0, z≠0 (1). What does mean? In terms of the equation system, this may be the value of (x); in terms of research specifically in hypothesis testing, it shows the time when the (x)-variable or causes have no significant effect or relationship to the problem under investigation, which means a zero relationship or null association or relationship. Moreover, (y) and (z) take any other value that is different from zero to be the solution to the equation; for the research hypothesis, this means that these variables or causes have a significant relationship with the problem under investigation. The second possibility is $x \neq 0, y = 0, z \neq 0$, which shows that the claim that the (y) variable has a significant relationship with (l), (m), and (n) was not found; in the other cases, we failed to reject the null hypothesis; in this case, (x) and (z) could have a significant relationship with variables (l), (m), and (n). When you continue up the last possibility the interpretation could be same but generally what does this mean? A hypothesis is a prediction statement that needs to be tested, you can study a number of causes to be the roots of the problem, and you find that some are the true causes of the issue you are addressing when are not, this where you need to prove or disapprove your hypothesis. Research could assess different causes of the problem, but not all will be the major cause of the problem under evaluation; this is the role of testing the true cause of the problem so that you plan the true strategies to prevent the cause of the problem. When you look at the fourth possibility of our hypothesis x=0, y=0, z≠0 only (z) was found to have a significant relationship with (l), (m), and

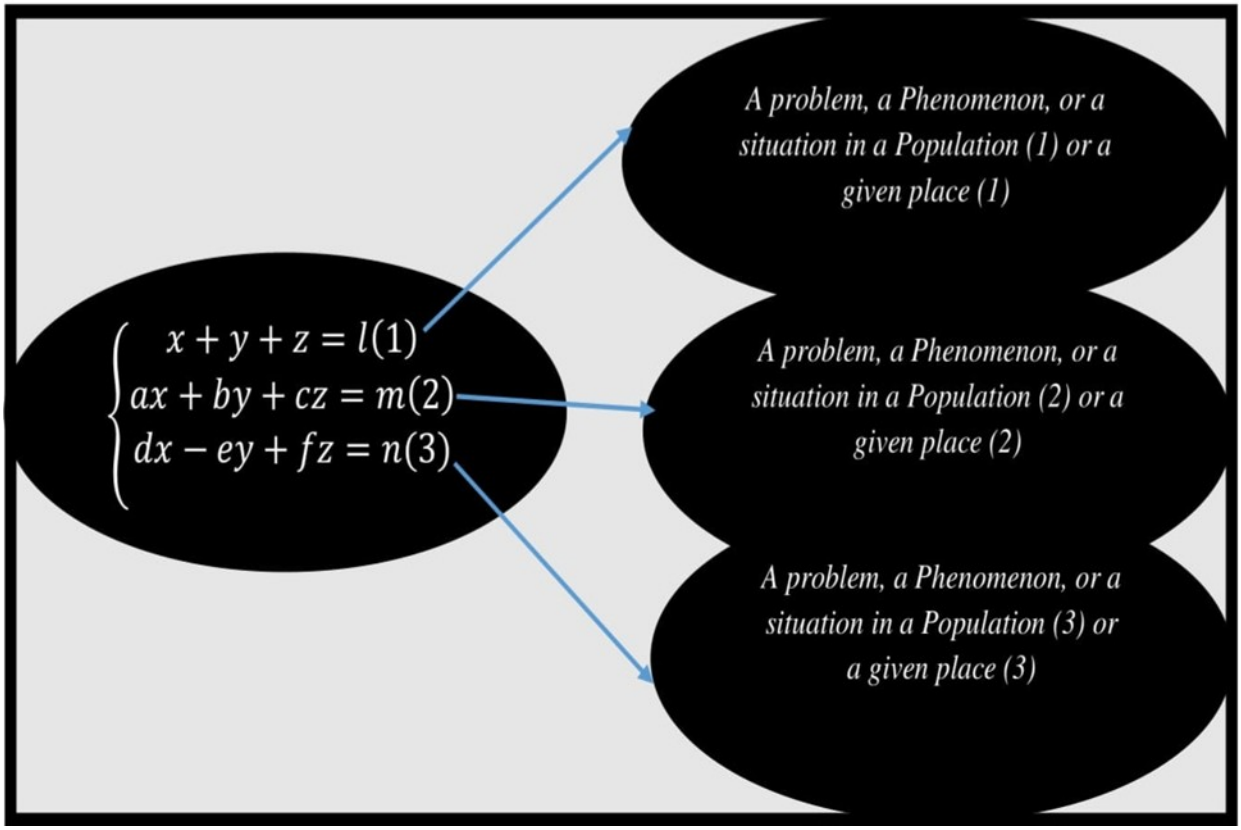

Fig 2. Occurrence and distribution of the problem in a given population

(n), showing that (x) and (y) causes were not considered the major cause of the problem or had a significant relationship with (l), (m), and (n) the major outcomes under consideration. The last two possibilities are very important to understand: one is where x#0, y≠0, and z≠0. In this case, all factors considered to be the cause of the problem under investigation were proven to be true, and they all showed a significant relationship to (l), (m), and (n). In this case, the researcher will have a large burden if he or she has a task to work on to prevent or eradicate the cause contributing to the problem. On the other hand, you can have this situation x=0, y=0, z=0 where all variables become null, what it symbolizes for this case, none of the causes you studied contributed to the problem under investigation, all causes did not show any effects to be the causes of the problem. A researcher can think or predict different causes of the problem when they are not true and when the problem is rooted in other causes rather than what the researcher has considered. If this is the case, the researcher could provide a conclusion referring to what the results of the study will be showing than any other imagination (**Fig 3**).

3.1.4. Guiding Principles of the equation as a tool to teach and learn the basics of research

Having a tool is one aspect, but knowing how the tool should be used is another aspect of importance. There is a need for guiding principles to understand when and how mathematical algebraic equations could be used as tools to understand the basics of research methodology.

First principle: Any type of equation can be used as a tool of teaching and learning basics of research methodology on the basis of the type of study population. What does this mean? A researcher could choose to use simple or linear equations when the study population is homogeneous and located in one place or a region. On the other hand, an algebraic equation system could be preferred in the case of a heterogeneous population located in either the same place or different places.

Second principle: When a researcher/investigator is studying one factor in a problem, an equation with one unknown or variable can be used. However, when the researcher is studying multiple factors in a problem, equations with multiple unknowns or variables can be used.

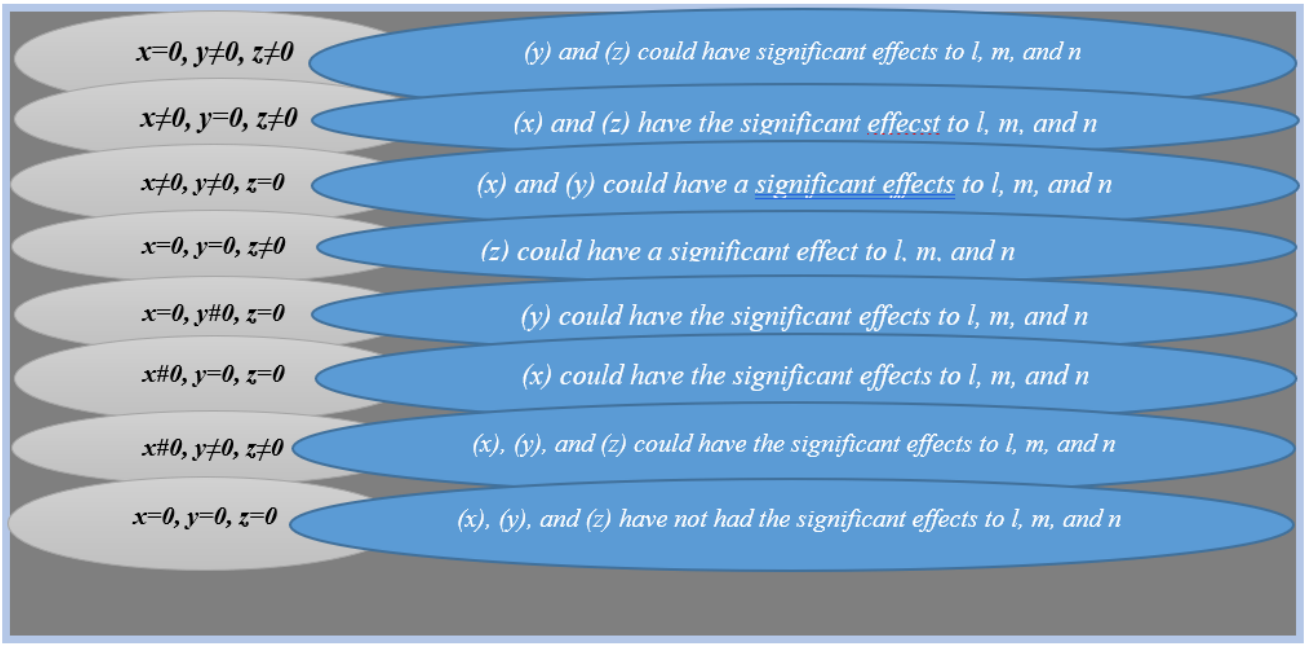

Fig 3. Research hypothesis approach from the equation system

Third Principle: In the case of homogeneous population with multiple factors to study in a problem, polynomial equation with multiple unknowns or variables (multivariate) can be used. On the other hand, when heterogeneous population has one factor to study in a problem more than one simple equation can be used (Table 2).

Note: in case the topic or research problem does not immediately specify fact number, the researcher can use look at objectives of the study to know which equation to use for explaining research methodology basics. The comparative and analysis approaches of equation components, research problems, and what the researcher is addressing to solve the problem are the key elements to consider when using equations as tools to teach or learn the basics of research methodology.

3.1.5. Pedagogical application and evaluation of theory

Teaching and learning are a continuing process from childhood to adulthood depending on school levels[11]. This is what we actually call pedagogy a term used to refer to the theory and practice of teaching and learning[12]. For this new tool of teaching and learning research methodology course, we have suggested some steps of the application of the theory a guide for students, teachers and lecturers who have the interest in the course. In activity one, lecturers were suggested to divide the students in different groups and give them an equation on the peace of paper. Each group should have the unique equation because research problems are different in terms of scope, affected individuals, nature, etc. Activity two, lecturers were suggested to ask different questions to the students after careful observation of the equation given. The response to these questions will help the lecturer and students to link the equation components and key research concepts. Examples of questions including what type of equation do you have on your paper? May be the answer is equation system with two unknowns or variables. This will help the lecturer to demonstrate and explain what it means in research methodology and link it to guiding principles. Having an equation system of 2 equations, primarily may be linked to a research with a problem- two different population in society either men and women, adults and adolescents etc. this may be a study whose problem affecting 2 regions. The lecturer will come discuss each equation in this way until he/she finishes all the equations provided to students. Having two unknowns in the equation, the lecturer should explain that in research we have what we are looking for or what we are searching for to provide a solution to the problem under investigation, thus the problem can come from 2 causes that is the meaning of having two unknowns in the equation and that is what it means in our theory as it was explained before, and this will be covered in the third activity. In the fourth activity, the lecturer will introduce a research methodology course, what is significantly here is that the lecturer tries to capture elements of research that are easily compared to the specific equations that students have used before grabbing them in the use of different types of equations. The activity five and six contain evaluation methodology where the lecturer will need to

Table 2. Principles of the equation as a tool of teaching and learning basics of research

Principles	Characteristics of the study population and Research Problem	Equation type	Research titles corresponding to the type of equation
First principle	Homogeneous population	$ax+b=l \quad (1)$	Association between smoking and chronic lung inflammation among elders in Musanze district, Rwanda. in this case a simple algebraic equation could be used.
	Heterogeneous population	$\begin{cases} ax+y=l \\ x+y=m \end{cases}$	Prevalence and risk factors of Hospital Acquired Infection (HAI) among health care providers. In this case, the algebraic equation system should be used because health care providers are heterogeneous, it includes Laboratory scientists, nurses and midwives, medical doctors, physiotherapist, etc.
Second Principle	One factor in a problem	$ax+c=l \quad (1)$	Prevalence of respiratory disorders among secondary smokers. Here the concern is only prevalence, the researcher can use a simple algebraic equation.
	Multiple factors in a problem	$\begin{cases} cx+by=l \\ dx+ey=m \end{cases}$	Assessment of Social demographic and political factors associated with negative mental health outcomes among pregnant women. In this case equation with 2 unknowns can be used.
Third Principle	Homogeneous population with multiple factors	$ax^3+xy^2+xy+cy^2+y=f$	Prevalence of asymptomatic and symptomatic bacteriuria among pregnant women in second trimester. ***(x)*** variable in the equation could be prevalence of asymptomatic bacteriuria while ***(y)*** represents symptomatic bacteriuria
	Heterogeneous population with one factor	$ax+x+b=c \quad (1)$ $cy+dy+c=h \quad (2)$	Prevalence of lung cancer among primary and secondary smokers. **Equation (1)** represents prevalence of lung cancer in primary smokers while **equation (2)** represents the prevalence of lung cancer among secondary smokers.

provide assignments and allow presentations for active learning, but also provide feedback to the students. The lecturer should provide assignments that are applied to different equations, and ask students to provide different research titles, and that will help them to understand the link between equations as tools and research methodology course. In evaluation of the tool, the lecturer will also ask the student to apply the principles of theory as indicated in Table 2. Now, this pedagogical application is divided in 3 periods. The first 3 activities will come before the research methodology course is introduced that is period 1 which contains studying and analysis of the equation as a tool to teach research methodology course, the period two is intermediate, it will include the introduction of the course and its details, and the last one is evaluative period. The application of this theory is suggested but a good teacher should base on what the students need to be successful in their courses, this suggestion is not limit to educators or lecturers, they can use any methodology that they can be more helpful depending on the nature of the class, capacity of the students to learn, the level of the students and of course the field of research. What is important to remember, is that the equation components should be linked to research methodology course concepts, not only to show the relationship between equation and research, but also to help the students understanding the course (Figure 4).

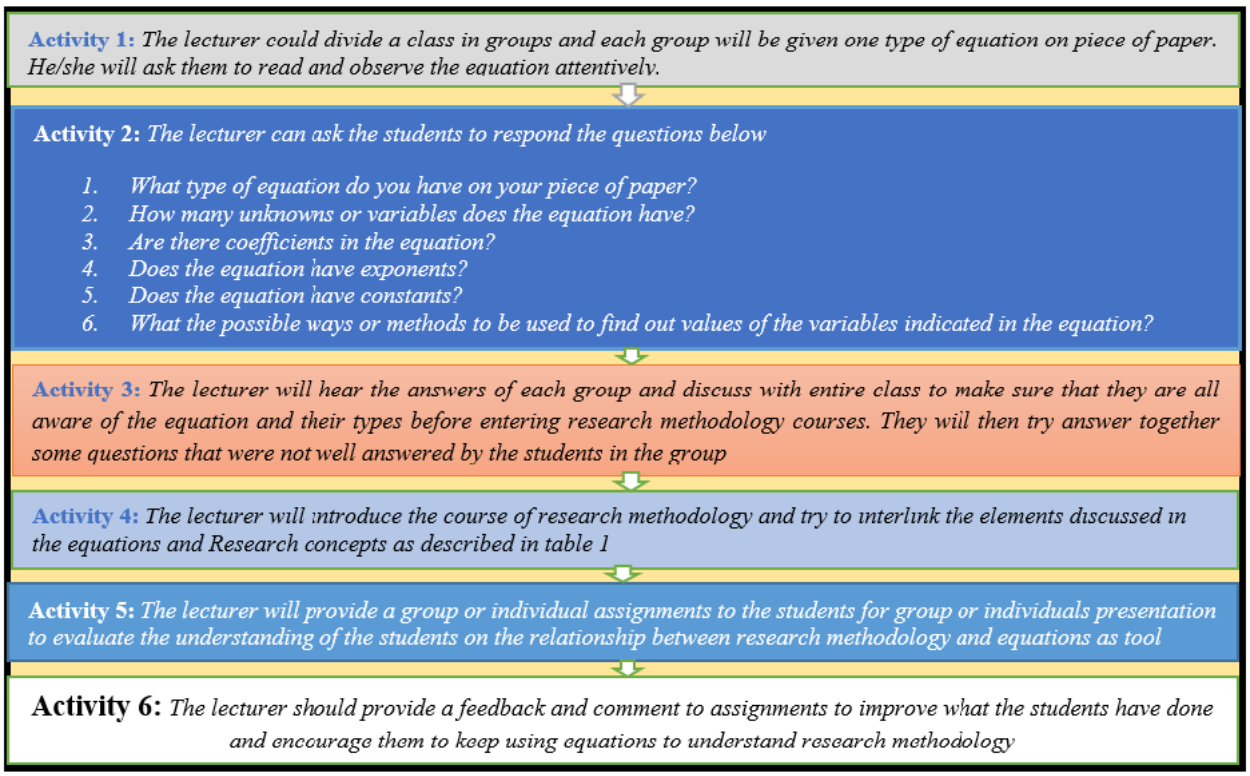

Fig 4. Pedagogical Application and Evaluation of the Theory

3.1.6. Novelty

As per our work title, we demonstrated mathematical equations as tools to understand the basics of the research methodology. No other work or study has discussed important aspects of research methodology as per our online search. This is the first work showing equation as a tool to study and teach research methodology. The fundamentals of research were included from the beginning to ensure that readers are guided through this great tool, which was discovered to be highly important for teaching research methodology. Authors also have put in place principles to be used in the application of the use of equations to explain research methodology. The use of this approach is more philosophical than mathematical, the user does not need to use calculations, he/she needs to understand why and what to do for a given mathematical equation**.** This is the new approach showing the relationship between research methodology and mathematical equations which is applied through the analysis and comparative approach of equation components and key research methodology course components**.** Translational interpretation of equation components to research methodology has been used to explain the key research concepts which was not done in existing literature, and this has highlighted the uniqueness of this new methods of teaching research methodology in higher education specifically for scientists.

3.2 Discussion

Mathematical equations were previously used in the sciences to understand other subjects and solve problems in real life[13]. In quantitative epidemiology, mathematical equations are utilized to interpret mathematical and epidemiological models designed to measure the dynamism and status of health outcomes, especially during outbreaks, epidemics, or pandemics[14]. Mathematical equations also play a significant role in architectural design activities and in physics, chemistry, and social sciences to provide solutions in both scientific and real-life communities[13]. In research, mathematical equations have been used mostly for sample size determination, hypothesis testing, and, in some other aspects such as quantitative data analysis[15]. Despite the role that mathematical equations play in science, there are still several gaps to explore for their application in other sciences, especially in terms of research methodology. Our work has gone through this gap and revealed that equations were not previously defined as tools to teach and lean research methodology courses despite having the same objectives and structure.

How did we start this theory? Every question starts from wondering, we looked at the aim of mathematical equations, which is to find solutions to unknown variables indicated in the equations, and at the same time, the aim of research methodology is to find solutions to existing problems either in scientific or social communities. With these similar objectives, we started discussing other similar components and discovered that equations are important tools for teaching research methodology and that they are easy to explain to students using their components and structures. The equation variables were compared with the variables in the research, the equation itself was compared with a problem under investigation in a population, the coefficients were compared with the frequencies of the variables in the study population, the methods applied to determine the value of the unknown variables in a given equation were compared with the methods or study designs used in the research to achieve the objectives of the proposed study, and other different aspects were compared (Table 1). Despite the lack of supportive statements in the previous studies, the comparative approach of the components of these two disciplines helped us to elaborate this theory and brought significant ideas to explain other research components via mathematical equation components. The conceptual framework is mostly used by social scientists to show the relationships among variables in a given phenomenon, situation or problem under investigation. With the use of the parts of the equation, the left side composed of the variables or unknowns, and the right side composed of the constants, we find that the left side made of unknowns has effects on the right side, which brought as the names of the independent variables or causes for the left side components and dependent variables for the right side of the equation. This was an important fun for us since it was not described before; it was a great concern to discuss and how it enters immediately to research conceptual frameworks that look also the relationship between variables to understand the problem under investigation. In this context, we have constructed a conceptual framework using the components of the equation and found that there is not much difference between the equation framework and the research framework except for the use of letters in the equation while wording is used in the research methodology (Figure 1). Although previous statements did not address this aspect, they highlighted the role of variables in research and clarified the conceptual framework as a way to understand the relationships among the variables of the problem under investigation, which has guided us in interpreting the equation framework. Understanding the equation framework constructed in this work is a great support to students and lecturers before talking about conceptual research frameworks since it will introduce them to the course and enter its application in research methodology when they understand what it means. For this purpose, an equation system with three unknowns was used to explain the occurrence of the problem in a heterogeneous population. In the equation system, **equation (1) in the system is considered a problem in population (1), equation (2) represents the problem in population (2), and the third equation in the system represents the problem in population (3)**. The concern here was that a problem can occur in different populations; it may occur in children and be more common than it occurs in adults or elders. The use of the three equations with 3 unknowns helped us understand how we can identify people at high risk of the problem observed. This is also a great aspect, as it shows how equations can be used to identify the risk of certain health outcomes in the affected population. Owing to its novelty and the fact that the aspects were identified the first time, we have elaborated principles to follow when using equations as a tool for learning research methodology. The first principle is based on the type of population; if the population is homogeneous, simple equations are preferred for use. A homogeneous population can be recruited in the same place or different places, which is more important than any other aspect to consider in this principle. The equation to be used may also be based on the researcher's judgment; he/she should be ready to explain why the equation was used to explain the research topic; otherwise, the principle provides a general guideline that is why they are not considered for laws. Another aspect of importance in the first principle is the case of heterogeneous subjects where the researcher can use an equation system, but the judgment of the researcher is not restricted. The main purpose of the principles highlighted is to provide guidance rather than laws; thus, the scientists and researchers are welcomed to judge which type of equation should be used. In the second principle, several factors were considered, where studying one factor in a problem was linked to the use of the equation with one unknown, and multiple factors in a problem were linked to the use of the equation with multiple unknowns. In our statement, the researcher can judge and find whether the equation selected fits the problem under investigation. Finally, the third principle is very specific to particularities, where we find that in a homogeneous population with multiple factors, the use of polynomial equations could be a good option. Simple separate equations could be used in the case of one factor in a heterogeneous population, but one simple equation could also be used despite heterogeneity of the population (Table 2). We have always talked to the statement that it is up to the individual to judge the equation he/she tends to use as a tool to teach and learn. To better understand which type of equation to use when teaching and learning research methodology, we may ask ourselves some questions, such as what type of equation do we need to use and why? Do we need to use a simple equation with one or multiple unknowns? Do we need an equation system? If so, how many unknowns do we need? Is the population homogeneous or heterogeneous? How many factors do researchers tend to evaluate or study? What are the objectives of the study? Upon responding to these questions and considering the advice and principles of this theory, it will be possible to clearly decide the right way to choose either the type of equation to use or the example of research topic to use when teaching and learning this course of importance in higher education. If the researcher

finds that it is not possible to use the equation because of the nature of the topic, he/she can use other examples or teaching aids since this tool is not intended to reject the existing ones but to be an added advantage to them. In this context, the pedagogical application was suggested, it contains main six activities to be done where the three first activities could be applied before the research methodology course is introduced, and the two activities were suggested to come after the course was introduced and the 4th activity in the middle will be the introduction of the research methodology course (Figure 4). The active learning which is about the involvement of all students in the teaching learning process was suggested to understand this tool and each step of the application can be followed for the purpose showing that the equation could easily support the students to understand research methodology course. This theory was designed specifically to describe mathematical equations as tools for teaching and learning research methodology course, however the theory can be limited for scholars and researchers without mathematics in their background. This unique work has also faced limitations in terms of existing literature, there is inadequate resources for this theory in the existing literature.

4 Conclusion

Lecturers and students should always use good tools that help them understand the given content of the course. There may be existing tools, but it is also possible to invent or design new tools to better understand the content. The mathematical equation, whether simple or simple, is a good tool for understanding the research methodology from the basis that we have described above. This new approach is very important because the main elements of the equation seem to be similar to the main elements of the research, which led to this approach. Scientists and researchers are advised to use this approach because it is simple to interpret and easy to understand since it does not involve any other requirement or calculation to be utilized; this approach is more useful when you are teaching a research methodology course or unit in tertiary institutions.

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