



PSYCHOLOGICAL FOUNDATIONS OF THE SCIENCE OF RESEARCH

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Abstract

The science of research is pentahedral. I define the science of research as, “study of research behavior of researchers” in relation to the wants and needs of the society, but under the frame work of the broadest perspective beyond the wants of an individual, total individual, and universal social organization”. The definition may be explained as: individual has wants (economics), he behaves as a unit (psychology), he behaves as an integral part of the whole, the social organization (sociology), and finally, with universal perspective (philosophy). The science of research has five foundations viz. sociological, philosophical, psychological, economical, and educational. Among the five, each one has got its own significance in visualizing and developing the science of research. Research is from the society, by the society, and for the society. Philosophy directs the research, the psychology is the real process of research, and economics economizes the research resources, efforts, process and products. The educational foundations serves two functions viz. (a) sustenance of research trends, and content for generations together and (b) facilitate enhancement of the research methods and content to keep up-to-date in flow of time. Hence forth, the second cycle starts – education to sociology, philosophy, psychology, economics to the third cycle and so on.

Key Words : Research Behavior (RB), Researcher's Behavior (Rs B), Research Out-comes (ROc), Learning Out-comes (LOc), Traditional Approach (TA), Scientific Approach (SA), Knowledge, Affect, and Skills (KAS), Taxonomy of Educational Objectives (ToE), Research Domain (RD), Taxonomy of Research (ToR).

A year ago, on one fine early hours of a day I dreamt. All days and nights of that month I have been constantly contemplating on taxonomy of research. Read it and decide whether I could become Kekule (who dreamt a snake with its tail in its mouth suggesting closed hexagonal structure for Benzene) or Einstein (who dreamt a continuous beam of light to suggest his theory of relativity).

There is a platinum mixed gold throne full of costly stones. On it a peerless and priceless prince prays. Around him are there mighty ministers: finance, education, social welfare, warfare, software, aviation, mines, and the like. Every minister had with him treasures of knowledge, affect, and skill of his portfolio. Billions of populations composed of different races, communities, continents, casts, cults et. hoc. are approaching the ministers. All the people are getting what they desire. All the ministers including the two prime ministers are happy and prospering day by day. Centuries are rolling..... There stood a humble person, a tailor with an indigenous tape tight in his hand wants to measure his physical get-up and mental make-up (personality) of the precious prince. It is surprising – neither the joyful benefactor masses, nor the ministers, nor the prime ministers, except the humble tailor are caring the prince. Mutually thanking cabinet and the people are dancing individually and in groups. In fact, the cabinet is a part of the thick population. The prince bestows all the property to the masses through the cabinet. But, anybody noticed the prince? No, never! None of them bothered for the needs of him.

Could the tiny tailor do his job? You are the judges !

Any science, as a matter of fact cannot have its existence without the support or frame of some foundations, otherwise known as dimensions or references. The science of

research is not at all an exception to this property. Though the science of research has its superiority over all other sciences, including its identical twin, education, it cannot have an escape from this property. In fact, any concrete or abstract object or concept bound to be comprehended by its references only. I am always being referred to as son, husband, father, or uncle of so and so only. The reference makes the unknown objects, persons, or concepts known to new persons intelligible. The simple educational principle is ‘known to unknown’. Our sister science education has four foundations viz. philosophy, psychology, sociology, and economics. Because of their close resemblance, both the sciences education and research ought to have the same or similar foundations. Today, for the science of education there are four foundations – philosophical, psychological, sociological, and economics of education as sub-fields. Now, with same treatment, the science of research should have four distinct, but well internally connected subfields – sociological, philosophical, psychological, and economics as sub-fields. This is declaration of the five inter-disciplines of the science of research. It’s an opening new vista of five new hybrid subjects. I announce the four sub-fields of the science of research and explain them – rationality of accepting them as sub-field of the science of research, scope, and nature in this chapter.

There are five such foundations for the science of research. You may call them as foundations, references, frames or dimensions. They are – Sociology, Philosophy, Psychology, Economics and Education. Further, the science of research and economics are policy sciences. Among them except philosophy the other three are behavioral and social sciences. Sociology is the science of study of behavior of social orga-

izations, psychology is the study of an individual in toto, and the economics is the study of rational human behavior in the endeavor to fulfill needs and wants. In short, economics studies a specific behavior, but the most influential behavior of an individual, psychology studies behavior of the individual as a unit, and sociology devoted to the study of social organizations, which is nothing but collective behavior of a set of such individuals. Philosophy studies comprehensive human behavior in relation to meta-physical, epistemological, and ethical issues. I define the science of research as, "study of research behavior of researchers' in relation to the wants of the society, but under the frame work of the broadest perspective beyond the wants of an individual, total individual, and universal social organization". The definition may be explained as: individual has wants (economics), he behaves as a unit (psychology), he behaves as an integral part of the whole, the social organization (sociology), and finally, with universal perspective (philosophy). Now, I attempt to elaborate the statement. Social necessity is the mother of invention. Invention is research. Any research is ***from the society, by the society and for the society, but never by an individual for an individual.*** Without a social need, real or perceived, discovery may not take place. Equally, without someone's having noticed the effect in the first place there would not have been a phenomenon to exploit. With this in mind let us visit some high points of discovery. We will see that man's curiosity is often influenced by practical considerations. Sometimes, the individual necessity may give rise to invent it, which could never be private for a longer time. Naturally, the society takes all such individual credits into its fold. An ancient treasure house found by an individual or individuals becomes societal, in no time for various reasons. Sometimes, the above process starts with not for to find solution for a problematic situation, but for a healthy practice also. We often say 'research and development', but not research alone. The NASA always attempts to explore the other planets, Mars, Jupiter, Saturn etc. for not seeking a solution to a burning problem, but for prosperity. Many nations launch space shuttles for communications and environmental study for development.

Research is a social process. Research is from the society, by the society, and for the society. When there is a need, the society cannot attend to it, because it has no physical existence. So, it operates research through an individual or a group. It supports the research work in terms of financial, human, and infrastructural resources and facilities. Ultimately, the final outcome would be for the society itself. Though apparently, a researcher feels the credit for himself, it is for the society and finally for the humanity on the whole. An example is enough to make my statement clear. Steam engine was invented and applied in the United Kingdom for the first time. For some time, say 300 years they enjoyed the benefits out of that – money, authority, royalty – and

gradually all nations learnt from them the technique and now, it is of every one the universal. Gradually, many revisions and improvements were made and after some time the first version of the steam engine was forgotten. The process here in this live example is research itself. Let us see another example – Indians, some centuries ago founded Yoga as psychological technique for the physical, mental, and spiritual health and they enjoyed its advantages and now it is accepted in the western countries, now it is universal. So, it is not an individual, group of individuals, small society, province, nation, group of nations, or continent, but the society to initiate and support the research for the welfare of the entire population of all contents. The narrowest, narrower, or narrow fragmentation is momentary only. My intension is to convey you the sociological foundation of the science of research.

Hierarchy of the five foundations : The social foundation initiates the research, the philosophical directs the research policy and process, the psychological actually operates and comes-out with out-comes, the economic foundations encashes its results for the individuals and society at any given time, while the educational foundation disseminates, leads, and ensures continuity of research for generations together. One generation via. education learns the research trends, methods and contents of research to hand-it-over to the next generation with its add-on. Thus, the educational foundations serves two functions viz. (a) sustenance of research trends, content and (b) facilitate enhancement of the research methods and content to keep up-to-date in the flow of time. Hence forth, the second cycle starts – education to sociology, philosophy, and so on.

Thus the hierarchy of foundations is – social, philosophical, psychological, economic, and educational. An examination of an example would clarify my stand. At one time, the disease TB was dreadful and dangerous one and it was believed and experienced that a TB patient was on his way to haven certainly. TB served as pass-port to the other world! This was a social menace. There stood the science of medicine with its researchers to rescue the humankind from it. The medical researchers were initiated and motivated by the society. Special training was designed for this purpose exclusively. Huge funds were provided by many governments and research on TB was on the priority list for projects and funding. However, the researches and researchers' were successful. Today, nobody is afraid of TB. If it attacks, no doubt we attack it and the patient is sure of his survival! The TB research when initiated by the society, took the second foundation, philosophical with its meta-physics, epistemology, and ethics. The method of research was mainly experimental, followed by clinical and case studies. The research design and process of experimentation was from the research behaviors of researchers'. This is the contribution of the third foundation. When once the research has successful, the desire of the society and need of the society

are satisfied. There appeared corporate pharmaceutical companies and hospitals on the scene at the macro economical level to make huge finances. They hired various professionals like, skilled and unskilled workers at various levels from the level of peons to CEOs, and scientists. In turn, they earned wages and fulfill the desires of themselves and their families at the micro-economic level. Here, the fourth foundation acted and it acts for ever as long as the disease TB is remembered in the world. The fifth foundation records the research findings along with its practical applications and hands it over to the young educators and researchers. In the case of Malaria, in spite of the identification its root cause, the mosquito was known the researches are still going on to eradicate them. The above described five foundations stands good in its research. Similar is the story of common cold though simple in its nature, very tough to control. It's a challenge to the world of researchers!

Psychological Foundation of the Science of Research :
The third pillar of the science of Research is the psychological foundation. This dimension is rather most powerful one and makes us understand the real process of the SoR, which enables us for measurement and evaluation of QR. It emphasizes the mental mechanisms behind SoR. The proposed SoR is being constructed and developed with the psychological foundations of ToR. Let us have a brief and clear grasp of the science of psychology so that a non-psychologist could understand and appreciate the ToR.

It has been agreed to that among the western sciences the psychology is the youngest science with its short history of just 133 years. In the year 1879, William Wundt had established the first psychological laboratory in Leipzig, a town in Germany. Prior to that, the psychology was a part of philosophy from the dawn of civilization on the earth. However, in the east there were rich psychologies which were not recognized as psychology for many reasons. In India, in BCE around 2nd century the sage Patanjali wrote a famous book, Yoga Sutras (aphorisms). Thus the first attempt to declare the psychology was made in India. Today, the west accepted the Yoga as a powerful technique of psychology. Yoga is defined as the process of controlling the mind. In the words of Patanjali, "Yogah cittavrtti-nirodhah". The definition of psychology in the modern western world is, "understanding, measuring, predicting, and controlling of animal behavior/consciousness/personality". Don't you find the commonness among the definition of psychology of east and west? Of course, psychology is psychology whether it is studied in east or west. However, the difference is in its assumptions, priority of the content, approaches, and methods.

There are many schools of psychology out of which some are buried with the elusive modern concepts, methods, and practices. Among the existing schools, behaviorism, gestalt, humanism, and psychoanalysis are living, while older schools; structuralism, functionalism, holistic are swept by

the force of new schools and thoughts. There are four streams of psychology viz. behaviorism, psychoanalysis, humanism, and trans-personal. If behaviorism is the most objective school, establishing psychology as a branch of biology with precision and objectivity, trans-personal psychology is quite opposite in its content, approaches, methods, and techniques. If the subject matter of psychology is the objective study of overt behavior of organism for a behaviorist, for the trans-personal it is the study of myth. The other two streams are intermediate in their fashion. We are more concerned with the behaviorist thought and to some extent extend to the psychoanalytic and humanistic when we deal with the ToR. We mostly, stick to the behaviorist psychology as we are studying the 'research behaviors of researchers. **We aim at understanding, measuring, predicting, and controlling the research behaviors of researchers.**

There are many branches of psychology. Every branch while limiting its study to a well defined domain of behavior, it contributes to whole science of psychology as such Clinical psychology, Counseling psychology, Cognitive psychology, Comparative psychology, Developmental psychology, Evolutionary psychology, Industrial and organizational psychology, Social psychology, Educational psychology, Experimental psychology, Physiological psychology, Philosophical psychology, Psychometry, Neuro-psychology, Forensic psychology and Psychology of Law

The proposed new branch, 'Psychology of Research'.

The oldest branch is philosophical psychology followed by educational psychology. The latest branch is psycho-biology and the developing branch is the neuro-psychology. Our present SoR falls is concerned with the branch of educational psychology, psychometry and neuro-psychology. It is the responsibility of educational psychologists to study the 'research behavior of researchers. They have taken the challenge of studying the 'teaching behavior of teachers and made much progress. As I have mentioned earlier in this book, two scientists – Bloom and his associates and Flanders developed the objective pedagogy which paved way for teaching to be scientific. The arts of teaching when embraced the scientific tinge also, it became comprehensive. Now, we enjoy the chastity of arts of teaching, but with scientific spirit. The efforts of Bloom and Flanders are in the mid-twentieth century which revolutionized teaching, and this book is the first attempt to revolutionize the research in the same fashion.

Leaving the readers to understand the science of psychology on their own, if they are interested, from the literature available, I limit myself to explain the psychology behind the SoR. The reason for depending on psychology is simple – psychology is the science of behavior of an individual. Now, my focus is to understand, measure, predict, and control of one particular aspect of human behavior, i.e. 'Research Behavior (RB)' of an individual, the researcher. So, I am applying the science of psychology to understand the research behavior. Though, as an individual the researcher

has many kinds of behaviors, our present interest is his RB. Again, we have to distinguish between two terms ‘researcher behavior’ and research behavior, just like ‘teacher behavior’ and ‘teaching behavior’. Teacher behavior includes a set of behaviors of teachers’ including specific behaviors he exhibits at the time of teaching. The term teachers’ behaviors (TB) is a broader term to connote a host of behavioral patterns that are related to teaching directly and indirectly, while RB is restricted to his behaviors while teaching only. If a teacher counsels his student on his family matters, it counts to be teachers’ behaviors, but not teaching behavior. TB is that behavior which teacher exhibits at the time of teaching implicitly and explicitly. Certain TBs are clearly visible while some others are not. Bloom has identified the TBs in behavioral terms like explains, identifies, finds errors, locates et.hoc. which signify teaching process. Some behaviors like role modeling doesn’t fall under TB, though it is closely related to teaching. So, also RB. Einstein inspired a good number of scientists. It’s a researcher behavior, but not RB.

Researcher behavior is something perceived by the public as well, but RB may be invisible to the pundits of that particular field only. There are behavioral correlates of researcher behaviors, say absent mindedness, doesn’t have the minimum common sense etc. are the common epithets for researchers. Newton is well known for his inattentiveness to his meal also. It is said that his students used to manage his dining table so that not even a single book or a piece of paper was not within the reach of his eyes. If he could see at least a piece of paper or a book, he would be attracted to it and as a result, for days together he would not dine! You know, once he had an apple in his hand for three days, because he would eat a piece and divert his attention to his research theme and this process made him to take three days to complete his eating the apple! This is typical researcher behavior, but not RB. In his case, RB may be represented as his analysis and ascribing a reason for the fall of an apple from the tree on to the ground, and finally generalization. In the case of Sigmund Freud, it is a serious thing. He had many bright students like Adler, Jung, Assagile, Carl Rogers etc. Inspiring them with his rich research innovations is an example of his research behavior and his theory of id, ego, and superego, or psycho-social developmental stages etc. are RBs. Most of his students broke away from him, because he has attached too much importance to sexual energy, libido in his psychology. Yes, inspiring his students with such thought provoking theories is really his researcher behavior. Researcher behaviors are the secondary behaviors associated with researchers, but primary are the RBs. Hundreds of such researcher behaviors might not yield any research product, but every RB invariably yields at least a small research out-put.

There is significant difference between TB and RB. TBs are rather stereo types of rewarded teaching acts. If a teacher

gets success for a given TB, it gets reinforced. If his colleagues and students may imitate the same RB for their success, it is nothing wrong. But in the case of RB it may not hold good.

Teaching and Research : There is clear difference between teaching and research. Both of them are ‘deliberate acts’. The teaching is a deliberate act, because at the out-set of teaching, the teacher starts with clear objectives of what he has to achieve. Teacher plans his teaching in terms of content, method/s, approached/s, T-L materials, and time schedule. He evaluates the learning gains of the students then and there and at the end also. His success in terms of students’ achievement is almost guaranteed. In the case of research, selection of the objectives, planning, and execution as per the schedule is ok. The researcher could do his job up-to this stage, but the results are not sure, may be failing many times without exemption. His unsuccessfulness is successful always. At last, may be unsuccessful as his life-time achievement. Thus, though central core of both teaching and research is learning, and both are deliberate acts, in case of results, teaching is sure of its gains, while that of research is ‘many/all times no’ only.

Educational Psychology did commendable work on taxonomy of teaching. The TE developed by Bloom and associates will serve as model for the proposed ToR. I gave a good account of the relation between TE and ToR. Again, in the next chapter I am giving a detailed report of the TE. In the first chapter I stated that the proposed ToSoR by professor Peri starts where Bloom’s ends.

Specific contribution of psychology to ToR can be stated as follows: Three branches of psychology; educational, psychometry, and neuro-psychology are the back-bones for the SoR. In fact, the subject matter of educational psychology is ‘learning’. The two constructs teaching and research are so closely connected through learning. The subject matter of research is also ‘learning’. The difference is that if you have learnt something through somebody, it is called as teaching, and if you learn something on your own, it is called as research. If you learn something so far unknown to anybody, it is research, and if you learn something so far unknown to anybody in the world, it is research. So, ‘learning’ is the subject matter of teaching as well research. Thus, the SoR is a legitimate topic of educational psychology. Again, educational psychology with its behavioral applications helps us in identifying the RB and researchers’ behaviors. We study teaching via teaching behavior of teachers’ and learning behavior of learners’. In the same way, we study the research behaviors of the researchers’. The difference is that in teaching at least two agents are evolved – the learner and the teacher, but in the case of research there is only one individual, the researcher. If there is any individual to teach the researcher, then the entire scheme of research automatically converts itself into teaching. In teaching the valuable consumer and the central figure is the learner, where as in

research, the researcher is mono and solo. I express the researcher in terms of teaching, as, 'the teacher and the taught are reduced to one individual, the taught'. In case of teaching, though the learner is the corner stone, the central figure and the consumer, the role and contribution of the teacher in the teaching-learning process is in-estimable. In spite of sweeping technological developments and non-human techniques of learning, the teacher became unavoidable and indispensable. Anything in the act of teaching is to supplement him only. As far as research is concerned, the researcher is the only one and success or failure is ascribed to him only. There is no counterpart to share with him. I want to convey that yet there are differences in teaching and research, both are involve behavior, teaching/learning behavior in the case of teaching, and learning behavior (of the anything new) in the case of research Thus, both are the study of behavior only. Even if a researcher learns a thing which is already known to all except himself, learning on his own and not knowing that it is a beaten track itself is research (of teaching, i.e. innovative teaching). Thus, study of research is the legitimate topic of educational psychology.

Taxonomy of Research : The scope of the proposed ToR includes measurement of research behavior and so, the role of psychometry is anticipated and appreciated. It guides us to construct, and standardize the tools necessary for measuring the RB objectively. In short, quantification of quality of Research Ability (RA) of the researchers as well Research Products (RP) is to be done with the aid of psychometry. In next chapters, I will come out with a plan of estimating the quality of research in the units, viz '**PERIS**'. The concept of Research Value (RV) in Peri units has arrived with the application of psychometry. Neuro-psychology is the most valuable contributor in this effort. Computational models of learning shall enable us to view the neural changes that occur in the brain of the researchers' during the process of research. Whatever we conclude about the research behavior thorough tests, it should be supported by the neural changes in the brain of the researcher. The correspondence between the test results and computational models strengthens and confirms our theory of research behavior.

Thus the educational psychology identifies and explains the RB, the key concept in the hub of ToR, psychometry helps in the measurement of RB, and neuro-psychology corroborates the theory developed by the educational psychology with its neurological correlates. To be more specific, psychometry helps us to standardize the tests to measure the quality of the Researchers' as well RP and lays down the principles to evaluate the QR. Verification of the strength of each RB in terms of the brain activity under-lies behind every RB is possible with computational modeling. So we owe to the psychology as a foundation of the science of Research. Scientific account of Researcher and Research Behaviors, Evolves taxonomy of the science of research,

Establishes research as pure science,
Measurement of Researcher and Research Behaviors,
Prediction of Researcher and Research Behaviors,
Control of Researcher and Research Behaviors,
Training the prospective researchers,
Evaluation of quality of researchers and research products,
Quality assurance of research products,
Determines effectiveness of various designs, and
Determines effectiveness of various research methods.

Conclude: The science of research has not taken its shape as it would have taken. There is an urgent need to draw our attention to it. We, educational psychologists did commendable work to empower the science of education, but didn't care for the same treatment for the science of research. As the first attempt the author wants to consolidate the fragments of the science of research found here and there to make it full-fledged science. In this long goal, as the first step, I conceived the science of research as pentahedral with sociology, philosophy, psychology, economics, and education as its foundations. In this paper introductory statement is followed by argument that psychology is the practical foundation since it studies the real process of research. The research behaviors of researchers are being studied via psychology and there are many advantages if we apply psychology in understanding the nature of research – planning, process, and products.

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