

Research Orientation Among Undergraduate Medical Students

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ABSTRACT:

There is increased demand for doctors in India and elsewhere throughout the world. Considering this, the government of India has taken initiatives to increase the number of medical colleges, thereby produce enough medical graduates to cater to the ever-increasing population of the country. Also, there is a debate over the quality of medical education provided by medical institutions. Therefore, the National medical council (NMC), the statutory body instituted by the government of India for governing medical practice and education, had taken several initiatives to improve the quality. One among them is the introduction of Medical Education Technology (MET) as a mandatory requirement for the teaching faculty. Another significant development in this direction is the change of curriculum that focuses more on the mandatory student's competencies in the patient management perspective. The new curriculum creates a space for students to perform research projects for a period of two months after the completion of the third year of study. We, therefore present a clear perspective on the teacher, learners' attitudes along with the overview of benefits and types of research.

KEYWORDS: doctors, medical graduates, medical institutions, curriculum, research, projects

INTRODUCTION:

Orientation is the attitude of a person towards a particular topic or an issue. The research is a never-ending process of studying and observing with prior knowledge. It generally involves working on a topic of interest that is aimed to draw a novel and an improved conclusion.

A teacher's role in a student's life is crucial because the attitudes of a teacher are carried forward by the students in their life [1]. Thus, a teacher should be able to inculcate kindness, sensitivity, motivation, discipline, stability, and ethics in the life of young and budding students. It is the teacher who shapes the professional life of a student [2].

Attitudes of teachers

A teacher must have a positive approach in receiving the ideas of the aspiring students [3]. Whether the idea is worth it or not has to be revealed to the student in an appropriate manner, thereby making them review their thought process. A sensible teacher makes wonders in the life of an upcoming student [4].

Negative attitudes of the teachers cause psychological disturbances in students and influence their overall performances [5]. It was concluded in a previous study that the use of humiliation, fear, and intimidation against students created shyness, anxiety, and habit disorders, which may finally lead to personality disorders in students [6]. The negative attitudes of the teacher, especially in elementary school children caused permanent effects on their whole life. This can be similar to post-traumatic stress disorder. The negative attitudes of teachers also affect students physically as noted by the development of muscle cramps, stomach upset, among others [7].

A Teacher should compete with the student while acquiring knowledge but never a teacher is supposed to perceive his/her student as a competitor or obstacle for their career development. This competitive attitude of the teacher causes students to lose their research attitudes and further degrades the big built image of the teacher in the student's heart. An ideal teacher would invoke a research attitude in students' minds by showing applications of the topics they teach. This stimulates logical reasoning in the mind of students. Most importantly, the lectures have to be made lively, which may include sharing one's own real-life experiences [8].

A good teacher must appreciate the research-orientated thinking of students, guide them, and give them enough time to envisage research work.

Among the various factors that contribute to a teacher's ability to cultivate research orientation in students include the teacher's hold on the language, his/her personality, listening abilities, valuing, fairness, encouragement, and adaptability. Other aspects including teacher's mastery over the subject, self-belief (the belief that one is efficient and can produce desired results), empowerment (achieving self-assigned goals), accountability, and attitude towards research make them self-evaluate critically and can help to interpret the behavior of students [9].

The role of a teacher in a student's life takes its shape from school days onwards [10]. Because early in life, the attitude and practices of the teacher is the one which influences the development of students. Teachers must productively use the time in classrooms to ensure that their students achieve deeper levels of understanding and metacognition (self-awareness and understanding one's thought process) [11].

Apart from the family members, the teacher is endowed with the personality development, academic and social performances of the students. The teacher's way of asking questions, understanding their thoughts, showing interest, and appreciation motivates them to try and achieve success.

A teacher with good communication skills and those having concern for their students will shape the student's psyche and prepare them to be considerate with others, help the needy, maintain good relations and positive attitudes towards people and life, respectively [12, 13].

In short, teachers are second only to parents in determining the personality development of students. Hence, teachers should keep this in mind irrespective of their working environments that include schools, colleges, and universities, etc. The teachers must never give unwanted stress to the students, that invariably damage them from the inside because as a student they spend most of their time with the teachers [1].

Benefits of student's research interest

The student's aptitude for research helps them to find and connect with the truth to practice. It increases and strengthens student's self-confidence and the thirst for knowledge in their respective areas of practice. The students learn to work as a team and while doing research they develop skills like creativity, planning, utilization of time, boosts morale and motivation, fast learning capabilities, encourages to take healthy risks, and relieves stress.

The research interest among the students allows them to develop interpersonal skills like speaking and listening, which allows them to communicate well with the patients. Working in small groups enhances the process of discussion which

makes them learn fast and increases subject retention rates. And most importantly, the students improve on trust, commitment, accountability, focus, and conflict management [14].

Research in academia

Research is considered mostly as a mode of career improvement or for promotion. Conversely, research is a continuous process that is generally undertaken by some academicians by interest. Unfortunately, people with research interests are forced to suffer due to the selfish nature of either the corporate management, the behavior of colleagues, and the heads of the departments who create obstacles/hurdles for research activities. Most research-oriented people are not supported, which invariably causes them to lose their interest. Similarly, the student's research orientation is greatly influenced by the institute and the teachers.

Teachers carry out research activities to enhance their salaries and to get recognized by the management of the institutes. They will not do research or apply it for the welfare of the student due to a lack of support from colleagues. In medicine, research updates are used by physicians and surgeons to improve their skills and career development. The post-graduate students carry out time-bound research in their respective fields to earn the degree.

Currently, the student orientation towards research is in a doubtful environment. Although students get inspired by a few research inclined teachers, sustenance of interest can be greatly influenced by the student's self-motivation, and time management, among others [15].

Research is a creative work, and in most instances, research is carried out for the benefit/well-being of humans and not just for the sake of pride, monetary benefits, and promotions. There is an urgent need to inculcate research attitude among the students from childhood. Also, it is important to follow a practically oriented method of teaching/learning to increase the research aptitude among the students. This is achieved if the management of educational institutions change their perspective and recognize the fact that education is not a business that aims to earn monetary benefits, rather it is a platform that generates innovations, inventions, discoveries that benefit mankind.

A guide to research process

Research can be defined as a process of systematic collection and documentation of data, analysis, and interpretation with suitable methodologies.

Benefits of student's research in the medical field include an improved understanding of clinical medicine, facilitates critical thinking and appraisal, improves future post-

graduate studies, develop teamwork skills, and exposes them to the best clinical minds[16].

The importance of student's orientation towards research includes a positive inclination on working for the benefits of mankind without expecting monetary benefits, research experience before post-graduation contributes to an improved selection process of the area of specialization, and publications produced from the research will also increase the scope of future research. Therefore, it is essential to make student research mandatory at the undergraduate level as a part of the medical curriculum[17].

Among the various types of research, the ones suitable for undergraduates include epidemiological studies, retrospective analyses, quality improvement (QI) studies, and translational research[18].

While planning research, the students at the undergraduate level must consider several factors that include time and cornering on to a specific research question. The students can benefit from spending some time observing the campus environment, and the patients while attending the clinical postings in the hospital. Then dig on to what may be

the probable reason for your research inclination and potential sources that may facilitate you to perform it.

Students should identify an appropriate peer/researcher with whom he/she wants to do research and consider him/her as a mentor/guide. Students must opt for a researcher who is polite, approachable, and who frankly shares his/her views without any hesitation. Students may benefit from approachable seniors on the campus or college, who can guide them in the process of research.

Topic selection is crucial, and therefore, students must be cautious while selecting. Research topics that are more interesting to you, the time factor, and the availability of sample/participants should be some of the criteria for topic selection.

Observational/epidemiological studies

Epidemiology deals with various factors that determine the presence or absence of a disease or a disorder in a population. It is a survey-based study wherein the answers from the people participating in the study are considered to assess the disease prevalence, predisposing, and other risk factors [19]. The major types of research studies are delineated in Table 1.

S.No.	Epidemiological study type	Applications
1	Observational study	Uses a predefined parameter, a group of predefined people, limited time period, and assesses the exposure to risks affecting the health.
2	Cross-sectional study/survey	Almost includes the entire population/random sample representative group. Uses questionnaire to collect the data in single contact. Tries to find the cause of a disease or the potential risk factors.
3	Case-control study	Assesses the history of exposure to risks in cases and compares them with the healthy controls with similar risk exposures, age, sex, and other sociodemographic characters.
4	Cohort study (longitudinal/prospective)	Groups of individuals with different exposure levels to potential risk factors. Participants are observed over a long time (months-years). Rates of disease/condition with respect to the exposure to risk factors is calculated
5	Experimental study	Alter exposures to risk among the study groups to examine the effects. Involves interventions and are usually randomized.

Table 1: Types of research studies and their applications

Cohort studies

Cohort studies are a type of panel/group study where the individuals in the panel have a common characteristic at a particular time. For example, the study participants may be suffering from the disease at a given time. The cohort studies are often used to obtain evidence between the cause and outcome of a disease or disorder[20]. The cohort studies may be either prospective(used in drug development studies wherein a defined age group people are given a drug and its side-effects are noticed and followed by treatment to relieve side effects) or retrospective (looking back in time E.g.: medical records). Prospective cohort studies give more reliable results than retrospective ones. The advantage of cohort studies includes multiple outcomes associated with a single exposure, and the long follow-up periods, increased costs are some disadvantages [21].

The plan for conducting a cohort study is shown in **Figure 1.F**

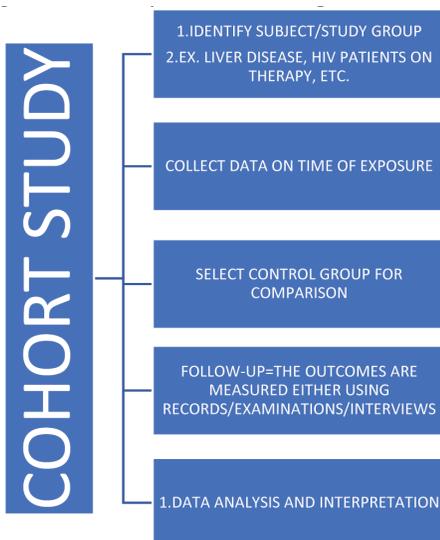


Figure 1: Workflow of cohort studies

Case control studies

These are a type of observational studies, where there is a comparison with a group having a particular disease and a group comprising of healthy individuals [22]. Case-control studies are used to study rare diseases and are mostly retrospective in nature. These studies help to determine the association between exposure and specific health conditions/disease. The case-control studies proceed from the effect/outcome to the cause [23, 24]. The advantages of case-control studies include quick, inexpensive, easy to perform, help in the investigation of outbreaks, and the study of rare diseases. The disadvantages are the difficulty in selecting the control group, and the potential bias associated with the observations made on the cause and the effect at the same time.

The research process of a case control study is shown in **Figure 2.**

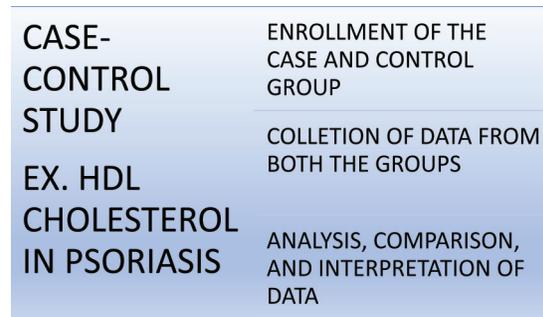


Figure 2: Workflow of case-control studies

Cross sectional studies

The cross-sectional studies are also called prevalence or transverse studies. These are observational, where the data is collected, analyzed, and compared at a specific time in a different population group[25]. The cross-sectional studies show the association between two variables with the prevalence of illness in a population and help in testing the scientific hypothesis.

The advantages of cross-sectional studies include low cost, takes less time for completion, and the data collected can be used for other studies. The disadvantages include the confirmation of the cause and effect, and the false answers to questions during a survey/interview generate a bias in the study.

The research process in a cross-sectional study is depicted in **Figure 3.**

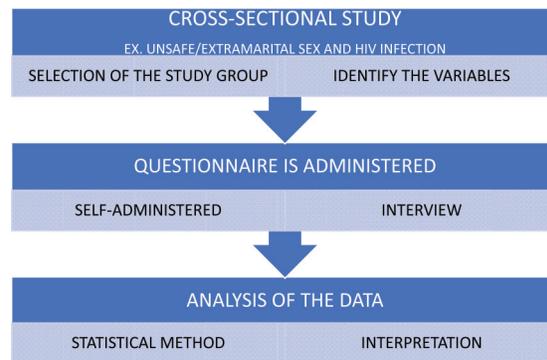


Figure 3: Workflow of cross-sectional studies

Interventional studies/experimental studies/clinical trials

Interventional studies are also called experimental studies[26]. These studies are generally referred to as clinical trial studies. In such studies, the device, test, or treatment given to people is assessed for their potential beneficial effects. The clinical trials help us to know whether the new drug or medical device or vaccine or a specific supplemental diet is safe and effective in humans [27]. There are five phases of clinical trials as delineated in Table 2.

S.No.	Phase of clinical trial	Type of study	Nature of study
1	Phase 0/ Micro dosing	Exploratory	Examines too low concentrations (micro dosing) of drug for less time is tested in 10-20 subjects, to study the pharmacokinetics and to determine the dose for phase I studies, and these are presently done in animals and future human micro dosing studies are expected
2	Phase I	Non-therapeutic trial	Around 20-50 healthy subjects are recruited. Establishes safe dose range, the maximum tolerated dose and examines the pharmacokinetic and pharmacodynamic effects, and these are generally single centre studies
3	Phase II	Exploratory	Recruiting around 5-100 patients of either sex. Examines the effective dosage and the therapeutic effects in patients, helps to decide the therapeutic regimen, drug-drug interactions, and these are generally, multicentre studies
4	Phase III	Therapeutic confirmatory trial	More than 300 patients of either sex are recruited in this study, it examines the efficacy and the safety of the drug, used to compare the test drug with the placebo/standard drug, and note down adverse drug reactions/adverse events
5	Phase IV	Post-approval study	After approval/post-licensure and post-marketing studies, following up of the patients for a very long time for potential adverse reactions and drug-drug interactions

Table 2: The phases of clinical trials

The major disadvantages of clinical trials include difficulty in interpreting the results, the increased risk associated with the novel drug, and the long-time intervals associated with the clinical study. The clinical trial study process is depicted in **Figure 4**.

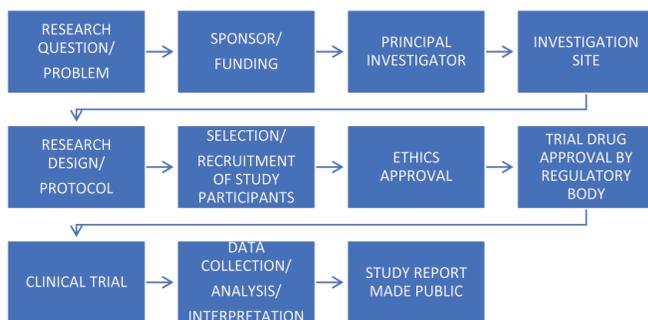


Figure 4: Workflow of a clinical trial study

Clinical research could be prospective or retrospective. It may also be a case-control study or a cohort study. Clinical trials may be initiated to find treatment, to prevent, to observe, and to diagnose a disease or a medical condition. The clinical trial studies are regulated nationally, and internationally by the respective agencies like the Indian Council of Medical Research (ICMR), and the Drug Controller General of India (DCGI) in India, and the Food and Drug Administration (FDA) of the United States of America (USA).

The principal guidelines of clinical research adhere to good clinical practices (GCPs), good manufacturing practices (GMP), and good laboratory practices (GLP) as proposed by the international conference of harmonization (ICH), Council for International Organizations of Medical Sciences (CIOMS), and the World Health Organization (WHO) [28].

The retrospective studies

These types of studies use the data that has been collected and stored in the form of medical records. Such studies are performed to find the relationship between exposures, suspected risk factors, and other contributing elements that may be associated with a particular disease.

The retrospective studies involve the collection of the samples and preserved information about past events associated with patients. In these studies, the history of patients is used to find associated risk factors for a disease/medical condition. Most cohort studies are retrospective ones. Retrospective studies help the researchers to investigate the rare outcomes of human diseases and can quickly estimate the results of exposure and obtaining a preliminary measure of the association where prospective studies are not possible [29].

Disease surveillance, the evolution of disease as well as the impact of treatment on survival and disease progression, comparisons of treatment modalities where clinical trials are

not possible, changing strategies of therapy according to predicted risk factors of a particular disease, inexpensive and fast, and helps in constructing future prospective study designs are among the various uses, and advantages of retrospective studies. The disadvantages of retrospective studies include the potential poor quality and the absence of important factors contributing to disease in stored data[30].

The research process while conducting a retrospective analysis is depicted in **Figure 5**.

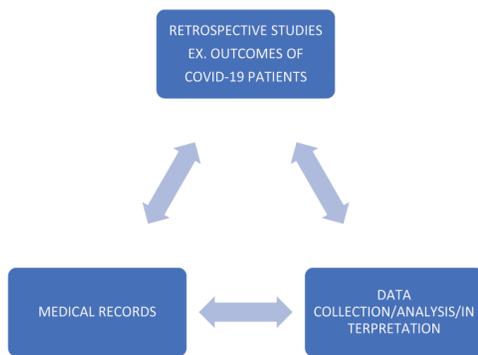


Figure 5: Workflow of retrospective studies

Quality improvement (QI) initiative research

The QI initiatives are the activities undertaken to improve an organization's operations and finances for the maintenance of the quality of the health care system[31]. It is achieved by evaluating and learning from past experiences [32]. The four key components of QI are problem, goal, aim, and measures as shown in **Figure 6**.



Figure 6: Workflow of quality initiative (QI) studies

Problem

Identify the problem and get an in-depth understanding of the problem. Here you have to define the quality improvement policy to the target problem.

Goal

Selecting a goal for quality improvement is a challenging task and it should be based on the return of

investment. The goal must have benefits both for organization as well as patients.

Aim

It helps the researcher to break the goal into manageable pieces for achievement.

Measures

The measure for QI can be initiated by performing an in-depth study of the results. The goal of QI is taken whether it is benefitting the patients and improving the organization's reputation has to be studied thoroughly to take appropriate measures of QI.

The keys for QI success lie in the adaptive leadership (the data driven QI process), analysis (checking whether goals are implemented), evidence-based practices to reach QI, adoption for delivery of quality affordable care, and financial management to avoid unnecessary wastage of resources [33].

The advantages of QI studies include quality improvement both for patient and management, improves the non-participant attitude of employers giving success, growth, and advancement to the organization, and helps in decreasing the waste and improving productivity and profitability to the organization. The QI studies also help the organizations to achieve the potential for market competition and improve communication[34].

The disadvantages of such studies include the requirement of extensive training of the employees, resistance by the employees to quality improvement programs which can lower their morale and affect the productivity of the organization. Also, the QIs discourage creativity and innovation and the organization has to spend extensively for training, team development, and infrastructure.

The essential elements of a QI research program include thinking differently (traditional quality control program has a loophole and there is a possibility of quality decline) systematic approach (clarity of goal, and planning accordingly), focused (clear vision and objective in such a way that everyone understands), Identification of supporting staff for the project (a team comprising sincere workers), time-bound (the team should be aware of acquisition of new skills in a short time), evaluation (transparent self-evaluation on improvement), documentation of results, and sustainability[35].

Translational research

This type of research translates fundamental research into medical practice and generates meaningful health benefits[36]. The product of translational research provides a new treatment that can be practically used either by clinicians or can be commercialized [37]. It takes a long period of time to

bring a change in the treatment plan, and hence, a dedicated department for research or designated research institutes can undertake this type of research[38].

The advantages of translational research include the potential of basic science advances becoming real-world benefits to people. The translational research helps in decreasing the time spent on pre-clinical trial studies involving a novel drug candidate (compound) as it gathers information on basic research results related to that compound[39]. The disadvantages of translational research are the lack of credit given for basic science research and the possibility of missing rare side effects while using the new method or compound in the treatment process[40].

The translational research has two stages referred to as the T1 stage, and T2 stage. The T1 stage translates from bench to bedside and includes the completion of preclinical studies and the development of clinical trial protocols. The T2 stage translates from bedside to community and it includes the adoption of new therapies and practices in the clinics of the community [41]. The process involved in translational research is depicted in **Figure 7**.

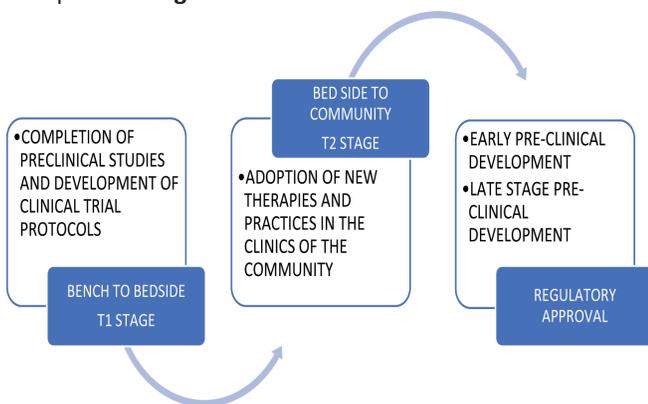


Figure 7: Workflow of translational studies

The early pre-clinical development involves assessment of formulas used for new drug development, planning testing strategies, and development of a protocol for the investigation new drug (IND) process is initiated.

In the late pre-clinical stage, the new drug is manufactured based on the formulas developed in the early preclinical stage. Also, at this stage, the study protocol is finalized, pharmacological and toxicological studies are conducted, and the application for an investigational new drug (IND) is submitted to FDA [42].

The FDA reviews the IND application for a month (30 days). In cases where the clinical trial issues are noticed by the authorities, the FDA holds the decision of approval[43, 44]. Once the issues are resolved, and in cases where there are no objections, the manufacturer gets FDA approval.

Case studies, literature reviews, systematic reviews, and meta-analyses

Because of several constraints associated with performing research work by the medical undergraduate students that include funding, time constraints, and others, we recommend other alternative methods to pursue research by medical students. These include writing a case report, case series, performing extensive literature surveys, and write literature reviews. Also, a medical undergraduate can take-up writing systematic reviews, and meta-analyses which are considered equal to doing original research.

The case study may include a description of a rare disease, observation of an uncommon clinical entity in otherwise common disease, and many other unusual findings that may be noted by the physicians/surgeons as a part of patient management [45, 46].

The literature reviews are written in a focused area highlighting the current and previous research findings and delineating potentially significant flaws and the areas of improvement that require further research studies. Literature reviews are highly cited research pieces that are generally written by experts in their respective fields. Nevertheless, medical graduates can identify their area of interest and can try writing small (mini-review) and extensive literature reviews (full-review).

The systematic reviews and meta-analyses that give the researchers credit on par with the original research follow almost the same procedures as done when a researcher attempts to perform original research work. Here, the researchers must identify a core area and write down the study protocol which contains a clear research question, and predefined methods (data collection repositories, studies inclusion, and exclusion criteria) that are reproducible. The researchers collect the data, analyze, and interpret the results, thereby making significant recommendations on an important aspect related to patient management.

The meta-analyses follow the same process as the systematic reviews but include the application of statistical methods for quantification of the data collected and to assess the statistical significance. Both the systematic reviews and meta-analyses minimize the selection bias and therefore are considered highly beneficial, especially while evaluating the data on drugs/treatments that are used for the management of diseases like cancer, Coronavirus disease-19 (COVID-19), and others [47].

The scoping reviews are a novel type of reviews that investigate the associations or present potential evidence of the associations. They may be considered as precursors for future research and can be supported by systematic analyses [48]. The types of reviews, their process, the potential for bias, and applications are shown in **Figure 8**.

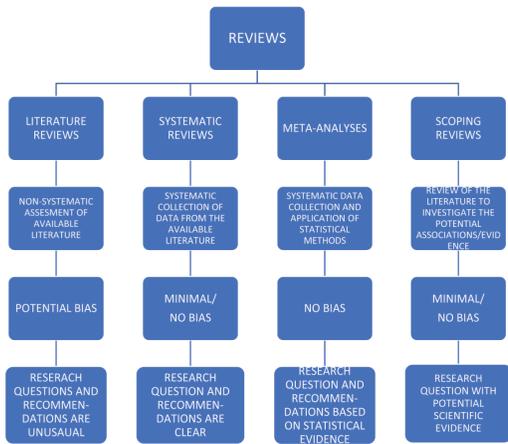


Figure 8: Types of review studies

Conclusion

Research is a part and parcel of education. The medical education prepares an individual to efficiently manage and treat patients. Learning is a continuous and life-long process wherein the individuals acquire knowledge and regularly update themselves with latest developments. Research in medical education would contribute to improved understanding of the subjects and potentially inculcate investigative abilities among students. This could pave the way for medical inventions and discoveries that invariably benefit public health.

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