

PROCEEDINGS

International Conference on Science Education

Postgraduate Institute of Science, University of Peradeniya, Sri Lanka

6th August 2022



■ Biology Education ■ Chemistry Education ■ ICT Education
■ Physics Education ■ General Science Education

**“Science Education for Sustainable Development:
Post Covid Challenges”**

Organized by the Board of Study in Science Education of PGIS, University of Peradeniya
in collaboration with the Faculty of Science, University of Peradeniya

**POSTGRADUATE INSTITUTE OF SCIENCE
UNIVERSITY OF PERADENIYA
SRI LANKA**



**INTERNATIONAL CONFERENCE ON SCIENCE
EDUCATION 2022
PROCEEDINGS
6th August 2022**

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International Conference on Science Education 2022

Message from the Vice Chancellor, University of Peradeniya



It is with great pleasure that I am adding my thoughts and warm wishes for the International Conference on Science Education -2022 organized by the Board of Study in Science Education of the Postgraduate Institute of Science in collaboration with the Faculty of Science, University of Peradeniya. There is no argument that the role played by science in today's society is for the betterment of human beings. Humankind is challenged by the Covid-19 pandemic which sent ripples through all sectors, including Education. Currently, as a country, we are also facing

many difficulties due to the ongoing economic woes that also brought many challenges to the education sector. Therefore, this conference with an aptly selected theme 'Science Education for Sustainable Development: Post-Covid Challenges' would provide an excellent platform for educators to bring innovative ideas to the forefront and to find solutions to some of these novel challenges the education sector is facing right now. Eventually, these findings will be useful to make some effective policy changes to meet national education goals while preparing our young generation to meet 21st-century challenges successfully.

Therefore, I sincerely hope that the outcome of this conference will contribute to finding ways to overcome challenges at present and facilitating Science Education during this critical period. I congratulate the Postgraduate Institute of Science and the Faculty of Science, and the organizing committee of the ICSE – 2022 for their respective efforts to hold this event with necessary dedication and determination. I also congratulate all the presenters and thank all the participants for their share of contributions to making this event a success.

I wish ICSE 2022 all the very best!

Professor M. D. Lamawansa

*Vice-Chancellor,
University of Peradeniya,
Sri Lanka*

International Conference on Science Education 2022

Message from the Director, Postgraduate Institute of Science



It is my pleasure to declare this message to the International Conference on Science Education 2022, organized by the Board of Study in Science Education of the Postgraduate Institute of Science (PGIS) in collaboration with the Faculty of Science, University of Peradeniya, Sri Lanka. I would like to congratulate and thank the organizing committee, led by Prof. Sumedha Madawala, for bringing together such an important event.

The environmental and social implications of the twenty-first century are key factors contributing to the national and global urgency to improve science education. Integrating biology, chemistry, physics, ICT and general science education in a meaningful context reflects the complex nature of global challenges and the necessity of training a new generation of experts in the science education sector. As we are all aware, educational practitioners, researchers, and policymakers point out that teachers always struggle to make connections across the many disciplines in science education. As a step forward in improving science education, countries have taken necessary steps to meet such challenges faced by educators. Considering the prevailing issues and recent developments in the education sector, this conference aims to exchange the latest research findings in the field of science education in the era of globalization. It will also provide an opportunity for researchers, educators, and postgraduate students to exchange ideas, communicate, and discuss research findings and new advancements in science education.

We look forward to an excellent meeting with an enthusiastic gathering from different disciplines in science education while sharing new and exciting findings.

I would like to extend my best wishes for a successful and fruitful conference while expressing my gratitude to the organizers of this event.

Professor H.M.T.G.A. Pitawala

*Director/Postgraduate Institute of Science,
University of Peradeniya,
Sri Lanka*

International Conference on Science Education 2022

Message from the Conference Chairperson



It is with great pleasure I am providing this message as the Chairperson of the International Conference on Science Education (ICSE – 2022) organized by the Board of Study in Science Education, Postgraduate Institute of Science, Peradeniya, to be held on 6th August, 2022. We are holding this event at a time the country is enduring the worst pandemic in the recent history, and the worst economic crisis since the independence. Understanding its significance, the Organizing Committee of the ICSE – 2022 was decided to hold this event with the most fitting theme ‘Science Education for Sustainable Development: Post-Covid Challenges’.

A sound education system is one of the main criteria to appraise a country’s economic prosperity. Thus, there is no dispute that maintaining the sustainability of the ‘Education’ system of a country is of utmost importance. The Covid-19 brought lasting challenges to the education sector affecting more than 185 million students world over. Despite many drawbacks in online teaching, it manages to maintain some continuity of the teaching-learning process. Recent studies revealed that even high-income countries experienced learning losses and increased inequality during this period. Learning losses due to the Covid-19 may inflict long-term negative impacts on children’s education, if not corrective measures taken. In order to address these post-Covid challenges in a more conducive manner, the policy makers should empower the working force with necessary skills and students with necessary facilities. Therefore, this event will not only provide teachers, educators and policy makers a platform to disseminate their findings but also to recognize lingering post-Covid issues and trends in the education system to build a better future for our children.

Finally, I would like to convey my sincere thanks to the Co-coordinators of this event, Dr. W.D. Chandrasena and Prof. Sakunthala Yatigamma, and the Secretary ICSE - 2022, Mr. Saumya Bandara for their resilience and dedication to make this event a success. I would also like to express my gratitude to Prof. H.M.T.G.A. Pitawala, Director, PGIS, Prof. Chandani Perera, Editor In Chief of ICSE – 2022 and all conveners and members of sub-committees for their unstinted support to make this event a success. Finally, I wish to thank all the presenters and co-authors for their contribution.

I wish you all a productive day!

Prof. H.M.S.P. Madawala

Chairperson/ICSE – 2022

International Conference on Science Education 2022

Message from the Editor-in-Chief



The aim of this International Conference on Science Education (ICSE) 2022 under the theme ‘Science Education for Sustainable Development: Post-Covid Challenges’ organized by the Postgraduate Institute of Science, University of Peradeniya, is to bring the researchers, educators, and practitioners who have been experiencing a significant educational impact of Covid 19 pandemic, to share their research findings in the field of Science Education and to encourage them to explore novel avenues and solutions to overcome these implications. The entire population in the country is facing a great challenge due to the transition from classroom learning to e-learning as a post-Covid impact the efforts taken by the Postgraduate Institute of Science (PGIS) to accelerate Science Education towards a sustainable future should be highly appreciated. At this juncture, it is my great pleasure to make a small contribution to academia by bringing up the Proceedings of ICSE 2022, a collection of 51 abstracts, sharing the research findings on virtual and in-class science teaching-learning processes adopted by a wide group of science education researchers.

We have received over 60 abstracts under five thematic areas: Biology Education, Chemistry Education, Physics Education, ICT Education, and General Science Education, addressing post-Covid challenges and other issues in the teaching-learning process at the primary and secondary education levels. All the abstracts were thoroughly reviewed by eminent academics and researchers in science education and based on their recommendation, 56 abstracts were accepted for presentation. The proceedings include all the accepted abstracts, and messages from the Vice-chancellor/University of Peradeniya, Prof. M.D. Lamawansa, the Director/Postgraduate Institute of Science, Professor H.M.T.G.A. Pitawala, the Conference Chairperson, Professor H.M.S.P. Madawala, the Editor-in-Chief, Professor A.D.L.C. Perera and the abstract of Keynote Speaker, eminent Science Educationist, Dr. J.S.H.Q. Perera.

The successful outcome of the Proceedings is a result of the collective efforts of authors, reviewers, members of the Editorial Committee, and the Editorial Assistant (Ms. Nirosha Dissanayake). Special thanks are due to all reviewers for timely reviewing of the papers while providing constructive valuable comments under very tight deadlines. The members of the Editorial Committee are very much appreciated for their dedicated editing of all abstracts. The final outcome would not have been possible without the continuous assistance and guidance of Professor H.M.T.G.A. Pitawala, Director/ PGIS, Professor H.M.S.P. Madawala, Conference Chairperson, Dr. WD Chandrasena, and Prof Sakunthala Yatigammana Ekanayake, Co-coordinators and Mr. Saumya Bandara, Conference Secretary. I would like to express my deepest appreciation to all the authors for their valuable contribution given to the ICSE 2022 by submitting their scholarly research papers to make the conference a success.

Prof. A.D.L. Chandani Perera

Editor-in-Chief/ICSE 2022

International Conference on Science Education 2022

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International Conference on Science Education 2022

A Brief Biography of Dr. J.S.H. Quintus Perera,

Keynote Speaker, ICSE 2022



Dr. Quintus Perera started his academic career as an Assistant Lecturer in the Department of Chemistry, University of Peradeniya, in 1974. He received B.Sc. Hon. Degree in Chemistry (First Class) from the University of Peradeniya in 1974 and Ph.D. from the University of British Columbia, Canada, in 1980. He returned to the University of Peradeniya in 1980 after receiving his Ph.D., was promoted to the post of Senior Lecturer and subsequently to Professor, and served the Department of Chemistry teaching Physical Chemistry until his resignation from the post of Professor in 2007.

Dr. Quintus Perera, a former Director of the Science Education Unit of the Faculty of Science, University of Peradeniya, immensely contributed to developing the human and physical resources and facilitated science publications in the unit. He conducted many outreach activities; popularized science among school children in underprivileged areas of the country by organizing science camps. He has supervised many postgraduate students' Science Education research projects and shared his expertise with the postgraduate students by conducting M.Sc. lectures at the Postgraduate Institute of Science.

Dr. Quintus Perera is a Fellow of the Institute of Chemistry, Ceylon (*F I Chem C*) and Chartered Chemist (*C Chem*). He won several Medals and Awards: Bikaji-Framji Khan Gold medal for Chemistry, University of Sri Lanka (1974), University of British Columbia Graduate Fellowship (1977-1980), Commonwealth Academic Fellowship (1990-1991), Natural Resources, Energy and Science Authority (Sri Lanka) Merit Award for Scientific Research (1993), His Majesty Sultan of Brunei Medal for Service Excellence (*PIKB Medal*) (2018).

Dr. Quintus Perera served the University Brunei Darussalam for 13 years teaching Chemistry Education and Science Education. He served as the Deputy Dean of the Faculty of Education (Sultan Hassanal Bolkuiah Institute of Education) and contributed to developing human and physical resources in the Institute of Education in Brunei. He was honored by the Government of Brunei for Excellence in Service and retired in 2018.

International Conference on Science Education 2022

The Abstract of the Keynote Speech of Dr. J.S.H. Quintus Perera

Science Education for Sustainable Development – Strategies to overcome challenges with special emphasis on chemistry

Enhancing students' understanding of scientific phenomena is a general goal of science education. The ability to advance these understandings depends on scientific thinking. The ability to think scientifically is an essential goal of science education as well as an essential feature of **scientific literacy**. One important aspect of scientific literacy is the awareness of the role science plays in the society and technology.

In, as early as, 1972, the report '*The Limits to Growth*' (Meadows et al., 1972) observed that an economy built on the continuous expansion of material consumption is **not** sustainable. The Brundtland report in 1987 noted that global environmental issues are primarily the result of the enormous poverty of the South and the non-sustainable patterns of consumption and production in the North. The report called for a strategy that could link development and the environment – described by the well-known term 'sustainable development'.

Education is perceived as the master key in achieving a sustainable society. UNESCO policy report, Education for a Sustainable Future in 2000, stated that '..... education is the most effective means that society possesses for confronting the challenges of the future...'. In late 2002, the United National Plenary Assembly proclaimed the Decade of Education for Sustainable Development (2005– 2014).

The aim of Education for Sustainable Development (ESD) has been stated as helping people to develop attitudes, skills, perspectives, and knowledge to make informed decisions relating to sustainable development, and to act upon these for the benefit of themselves and others, now and in the future. Education helps students to achieve cognitive, social and emotional, and behavioural dimensions of learning through ESD. The United Nations have identified 17 Sustainable Development Goals (SGD) to be achieved by 2030. Many of these goals have a close association with the subjects that we cover in science education. However, despite its early recommendations that go back as far as 1974, a recent UNESCO study showed that ESD is mostly associated with teaching of scientific knowledge on environment, which is not sufficient to bring the transformative power of education to its full force.

One of the major limitations in the effective incorporation of ESD outcomes in school curricula seems to be the lack of suitable pedagogical models. In this presentation, strategies for incorporating ESD in curricula will be presented with special emphasis on chemistry education.

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THE IMPACT OF MATHEMATICS TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE ON ALGEBRAIC SYMBOLS AND VARIABLES

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The pedagogical content knowledge (PCK) of mathematics teachers plays a vital role in students' understanding of algebra. Recent research on mathematics teachers' PCK revealed that mathematics teachers' PCK is inadequate, and it strongly affects the learning of algebraic symbols and variables. The objective of this study was to examine the PCK of secondary-level mathematics teachers in teaching symbols and variables at the acquisition stage of the school curriculum. A questionnaire containing closed type, selection type, and open-ended questions to measure PCK was administered to 281 mathematics teachers in the Galle Education Zone. The focus of the questionnaire was the three knowledge domains of mathematics teachers: the building of mathematics concepts in students' minds, addressing the students' misconceptions, and understanding students' thinking. The research design was a survey type using the quantitative research approach, and the data were analysed using SPSS statistical software. The data obtained from 281 mathematics teachers were analysed by using SPSS statistical software. The sample of the study represented 96% of the population. The results of the study revealed that the mathematics teachers' PCK in Algebra is at a medium level in which 83% of the teachers received marks between 30 and 50 out of 100. But the study results indicated that the teachers' PCK with respect to algebraic symbols is below average, as 80% of the sample scored below 10 out of 20. Marks of the teachers on variables were computed and the results showed that 75% of teachers obtained marks below 10 out of 19. The research revealed that the mathematics teachers' PCK with respect to algebraic symbols and variables is not in a satisfactory level for introducing basic algebraic concepts. Therefore, to achieve the targets of students' mathematical outcomes, mathematics teachers' PCK should be further developed through professional development programs, focusing on the basic algebraic concepts and the other abstract concepts in mathematics.

Keywords: Algebra, Algebraic symbols, Pedagogical content knowledge, Secondary level mathematics teacher, Variables

APPLICATION OF MULTIPLE REPRESENTATIONAL MODELS IN TEACHING CHEMICAL BONDS IN GRADE 10 CHEMISTRY

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In Sri Lanka, students start learning basic concepts of chemical bonding in 10th Grade, and for most of the students, it is a challenging subject to learn due to the abstract, unobservable, and articulate basis of chemistry concepts. Previous studies reveal that conceptual understanding in chemistry relates to the ability to explain chemical phenomena using macroscopic, submicroscopic/molecular, and symbolic levels of representations. The objectives of this study were to identify the difficulties in chemical bonding learned by Grade 10 students, determine the effectiveness of the Multiple Representational Model (MRM) for teaching chemical bonds, and enhance students' performance. The sample consisted of 193 students selected from five classes of Grade 10 from a 1AB school in Southern Province, Sri Lanka. A pre-test was conducted to determine the students' level of understanding of certain basic concepts of chemical bonds. The research sample was selected by stratified random sampling technique and then experimental (EG) and control (CG) groups were selected. In the experimental class, the lessons were conducted using a teaching approach based on MRM, while for the CG, a conventional approach was used. The results show that the mean pre-test scores for the EG (51.28%) are relatively similar to the mean pre-test scores of the CG (51.47%). After completion of the teaching-learning process, both groups were subjected to the post-test. The results in the post-test of the EG (61.64%, $p < 0.05$) demonstrated a statistically significant increase over those of the CG (52.67%, $p > 0.05$). Calculated Cohen's D for the EG was 0.39, which implies that the teaching method based on MRM has a moderate effect on the performance of students in the experimental group. Therefore, it can be concluded that learning with MRM is more effective than conventional learning in understanding the concepts of chemical bonds.

Keywords: Chemical bonds, Chemistry concepts, Misconceptions, Multiple representational models

REDUCING LEARNING DIFFICULTIES IN GEOMETRY IN GRADE 10 – A SPECIAL REFERENCE TO A SELECTED SCHOOL IN JAFFNA EDUCATIONAL ZONE

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Statistics from the Department of Examinations of Sri Lanka reveal that students avoid answering geometry questions in the General Certificate of Education (G.C.E) (Ordinary Level) examination. This study was conducted to identify the strategies to reduce learning difficulties in geometry and to make recommendations on how to implement such strategies. This study was conducted by selecting students in Grade 10 in a selected school in the Jaffna Education Zone. The sample consisted of 20 students who obtained less than 40 marks out of 100 in a standard geometry test. Focus group discussions and pre-test and post-tests were used as data collection instruments. Based on the output of focus group discussion and pre-test marks, team teaching, micro-teaching, peer group study activities, and laboratory teaching methods were used as remedial teaching techniques to reduce learning difficulties in geometry components. The difference between the pre-test and post-test marks was analysed by Pearson's multiplier coefficient method. A positive coefficient of 0.95 was observed. Based on the improvement of the geometry scores, factors responsible for reducing the learning difficulties in geometry were explored. Well-planned and implemented teaching and learning activities such as strengthening teacher-student interaction, using familiar teaching-learning tools, and creating opportunities for students to work in groups and individually in a pleasant environment reduce the learning difficulties in geometry and increase the achievement level also. This study confirmed that the activities mentioned above have improved the basic conceptual interpretation of geometry among the students.

Keywords: Geometry, Grade 10, Jaffna, Learning difficulties

PARENTS ROLE IN INCULCATING 21st CENTURY SKILLS IN ONLINE EDUCATION AMONG SCHOOLCHILDREN DURING COVID-19

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During Covid-19 Pandemic the task of supporting children's learning has fallen on parents at a much greater rate than ever before. Now the status quo of education and training has changed all over the world. Parents started to play instrumental roles in children's education. Taking into consideration the parents' involvement the researchers planned eight-week online summer camp activities to develop various 21st-century skills among semi-urban school students of Maharashtra, India. It included Project-Based Learning (PBL) and Activity Based Learning (ABL) in Science, Arts, and Mathematics. A hobby session was designed to make children's leisure enjoyable and stress-free. A qualitative descriptive design was administered on 23 parents and 35 students. Data was collected using semi-structured interviews, projects, and visual arts made by students. Content analysis was carried out. Parent interviews and teachers' observations show the inculcation of 21st-century skills among students. Students learned the concept of distance and direction, quantity of material needed per month, concept of proportion, and physical & chemical changes in our surroundings which show their critical thinking. Collaboration was observed as students worked together on projects and activities with parents and siblings. Creativity was seen in the designing of PPT and visual art. They effectively conveyed ideas during online presentations of visual arts and PPT; it showed communication skills. Data gathering for PBL activities from vast internet access and its presentation by gathering trustworthy information shows Information, Media, and Technology (IMT) literacy. They showed social skills by observing etiquette, manners, politeness, responsibility, honesty, fairness, etc. They understood the importance of water, learnt how to make tea, coffee, etc. which is a part of life skills. The study showed parents tied together what children learnt in school and out of school. They are the link between schools to real-life situations. As parents spent more time with their children it helped children develop 21st-century skills. Thus, inculcation of 21st-century skills can be possible through the collaboration of technology, teachers, parents, and children which in turn maximizes the benefits promised by sociocultural learning theories.

Financial assistance from the Government of India, Department of Atomic Energy (Grant No RTI4001) is acknowledged.

Keywords: 21st Century skills, Covid-19 pandemic, Online school education, Parents' role, Sociocultural learning theories

GAMIFYING THE ORDER OF OPERATIONS IN MATHEMATICS ONLINE EDUCATION

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The current study is a single group pre- and post-test experimental study to examine the effect of gamification on the concept of solving Order of Operations in Mathematics during online education. A purposive sample of 26 Grade 6 students was taken, and five online sessions of one hour each as an intervention program were conducted on the Zoom platform where the concept of BODMAS was explained based on the increasing difficulty level during each session. During the introductory session, the researchers introduced the students to game-based learning tools and conducted a quiz using <http://quizizz.com> as a pre-test. The test was designed using 20 multiple choice questions with one mark for each correct answer. The same test was used as a post-test which was conducted at the end of the intervention program. For the next session, the researchers conducted online sessions for teaching the order of operations. For assignments, the researchers used a game-based learning tool. During the last session Order Ops - Online Game (<https://mrnussbaum.com/order-ops-online-game>) was conducted in live mode. As the students practiced using the Quizizz tool they proceeded easily from lower level to higher level of difficulty. It helped students to reinforce their skills as well as challenged them to improve upon skills they already possess. The t-test analysis shows that the comparison between pre-test and post-test showed differences in academic performance as the mean score for the post-test ($M = 0.88235$, $SD = 18.88235$) was considerably higher than that of ($M = 0.73529$, $SD = 1.485294$) the pre-test. It shows that gamification improves the performance of students and engages them in solving order of operations. In addition, the study shows it helped students to evaluate their academic performance in formative assessment, provide them feedback, improve their knowledge, and support fun and competition-based learning.

Financial assistance from the Government of India, Department of Atomic Energy (Grant No RTI4001) is acknowledged.

Keywords: Gamification, Formative assessment, Fun-based learning, Online education, Order of operations

**STEM-BASED SCIENCE TEACHING-LEARNING: FACILITATING
SUSTAINABILITY COMPETENCY DEVELOPMENT AT THE JUNIOR
SECONDARY LEVEL**

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The prevailing pandemic has dramatically affected almost all the dimensions of human life and resulted in several issues requiring steady, constructive, and innovative solutions. There, education is a crucial requirement and especially the STEM approach has been accepted as an effective interdisciplinary education model to develop skills in students for the 21st century challenges. It also plays a critical role in its way of education for sustainability: to develop individuals with the values and the motivation to take action for sustainability within them, their community, and globally, now and in the future. STEM-based teaching-learning is really a novel experience for the Sri Lankan school education as STEM is not practiced in the Sri Lankan context. Basically, this study aimed to examine how STEM-based science teaching-learning facilitates sustainability competency development at the junior secondary level. The study followed a qualitative approach and a sample of 35, 8th Grade students from a school in Kandy, Sri Lanka, was purposively selected. They were exposed to STEM-based science lessons focused on two different themes, Electricity and Life Cycles, within a month for two days per week. Qualitative data obtained from lesson observations (n = 10) and random student interviews (n = 15) were analysed using a thematic approach. Findings revealed that the majority of the students prefer working in groups and they enjoyed sharing their ideas, findings, and creations, especially through group chats. Further, it identified that some students have been motivated to apply the acquired knowledge to make models and are involved in creative activities. According to those findings, it is obvious that STEM-based science teaching-learning enhances creativity, collaborative learning skills, and meaningful application of acquired knowledge and social skills. Moreover, it was identified that student-centred pedagogical approaches enhance sustainability competency development. Hence, implementing STEM approaches will accelerate the process for a sustainable future.

Keywords: Science Education, STEM Education, Sustainability competency

RELATIONS OF TEACHING METHODS WITH SECONDARY STUDENTS' INTRINSIC MOTIVATION, SELF-CONCEPT, AND ACHIEVEMENT IN SCIENCE

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The impact of science is visible in every aspect of our existence. Thus, Science Education plays a vital role in the economic progression of the country. Students with intrinsic motivation are well-engaged, enquiring, attentive, and willing to participate in the learning process. In addition, educational and career aspirations and self-concept also promote performance in science education. This study aimed at investigating the relations of secondary level students' intrinsic motivation and aspirations with their self-concepts and achievements in science. This is a quantitative study and the sample consisted of 2,384 students from Grades 8 and 9 from selected schools in Kegalle and Dehiowita Education Zones, Sabaragamuwa Province, Sri Lanka. An intervention was launched to discover students' intrinsic motivation, aspirations, self-concept, and achievements using different teaching methods and strategies. Students' intrinsic motivation, aspirations, and achievements were measured using the same multidimensional questionnaire before and after the intervention in both experimental and control groups. Achievements were measured using pre-test and post-test. Results reveal a strong positive relationship between students' intrinsic motivation (IM) and aspirations (AP) with their self-concept (SC) and achievement (AC) in science ($r = 0.934/IM - SC$; $0.926/IM - AC$; $0.691/AP - SC$; $0.687/AP - AC$) in the experimental group, while an insignificant low positive relationship in the control group ($r = 0.093/IM - SC$; $0.058/IM - AC$; $0.012/AP - SC$; $0.006/AP - AC$). Significant differences were also observed with students' intrinsic motivation, aspirations, self-concept and achievements before and after the intervention ($t = 51.926, p = 0.000/IM - SC$; $t = 48.513, p = 0.000/IM - AC$; $t = 53.689, p = 0.000/AP - SC$; $t = 65.939, p = 0.000/AP - AC$) in the experimental group, whereas, the control group showed no such significant differences ($t = -0.5, p = 0.323/IM - SC$; $t = -0.989, p = 0.116/IM - AC$; $t = 1.572, p = 0.617/AP - SC$; $0.968, p = 0.333/AP - AC$). Thus, the findings of the study provided a greater understanding to develop suitable teaching and learning methodologies to enhance science education through students' intrinsic motivation, aspirations, and self-concept.

Keywords: Achievements, Aspirations, Intrinsic motivation, Self-Concept

FACTORS IMPACT ON UNIVERSITY TEACHERS' ADOPTION AND INTEGRATION OF ICT IN TEACHING AND LEARNING: A CASE STUDY ON EASTERN UNIVERSITY, SRI LANKA

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The adoption of ICT has suddenly become a significant concern due to the covid-19 pandemic. The integration of ICT in to the field of education is significant. Teachers in various faculties use different teaching approaches. It prompted the researcher to investigate the factors influencing university teachers' adoption of ICT in education. A paper-based quantitative survey was used to collect data from teachers at the Eastern University of Sri Lanka (EUSL). A convenience sample method was used. Teachers from several faculties were given structured questionnaires. The internal reliability of the instrument was satisfactory (Cronbach's alpha = 0.862). A total of 155 questionnaires were validated for data processing, suggesting an 86% response rate. The result of the descriptive statistics shows under the following categories. Gender (female - 58.7%, male - 41.3%), age groups (25 to 34 - 56.1%, 35 to 44 - 16.8%, 35 to 54 - 21.3%, above 55 - 5.8%), academic qualifications (bachelor's degree-68.4%, master's degree-23.8%, doctoral degree-7.8%), teaching stream (Fine Arts-29.7%, Arts-16.8%, Agriculture-13.5%, Information Technology/Computer Science-12.3%, Management-12.3%, Science-15.5%). As the dependent variable - ICT adoption in teaching and learning, was not normally distributed ($p < 0.05$), a nonparametric correlation analysis (Spearman's correlation) was used to evaluate the related factors and university teachers' adoption and integration of ICT in teaching and learning. The results revealed that all the independent variables show a positive correlation with the dependent variable except for external barriers to the use of ICT. The ICT competence ($\rho = 0.289$, $p < 0.001$) and teachers' workload ($\rho = 0.350$, $p < 0.001$) are weakly positively correlated with university teachers' adoption and integration of ICT in teaching and learning. Teaching experience ($\rho = 0.434$, $p < 0.001$), institutional characteristics ($\rho = 0.479$, $p < 0.001$) and perception concerning ICT-related courses ($\rho = 0.557$, $p < 0.001$) are moderately positively correlated with university teachers' adoption and integration in ICT teaching and learning. Finally, external barriers to the use of ICT ($\rho = 0.091$, $p = 0.262$) are not significantly correlated with university teachers' adoption and integration in teaching and learning. These findings concluded that well-equipped institutional infrastructure, good technical support, and a good perception of ICT-related courses motivate adopting ICT in teaching and learning. External barriers such as time, lack of knowledge, and institutional support could not scale back to the integration of ICT in teaching and learning. The study recommends that both administrators and academics can benefit from the findings concerning bridging the gap of ICT utilization in the pedagogical system.

Keywords: Factors, ICT, Teaching-Learning process

**STUDENT PERFORMANCE OF CONCEPTS IN MECHANICS IN G.C.E. (O/L)
SCIENCE: A CASE STUDY AT ANAMADUWA EDUCATION DIVISION**

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The student performance in science in the General Certificate of Education Ordinary Level (G.C.E. (O/L)) examination is not at a satisfactory level in recent past years. One of the major reasons for the poor performance in the G.C.E. (O/L) science paper seems to be the inequality in students' performance in the three major subject areas of the G.C.E. (O/L) science curriculum, namely, physics, chemistry, and biology. Identifying abstract concepts and key factors that influence student academic performance is essential to providing timely and effective support interventions. The purpose of this study is to identify 'students' performance and factors related to the section of Mechanics as it is one of the fundamental and weighty components of the physics subject in the G.C.E. (O/L) curriculum. The data were collected from a survey conducted in 19 selected schools in Anamaduwa Education Division. A sample of 21 teachers and 250 students in Grade 10 were selected using a random sampling method. The data were collected through structured questionnaires, interviews, and a test paper and were analysed using a computerized data analysis package, Statistical Package for Social Science (SPSS) 17.0. An independent sample t-test was used to find out how academic performance varied with the attitude of the students, and an ANOVA test was used to test the variation of the academic performance in study sites. Percentages and mean values were used for the comparison of data analysis. Based on the findings, it can be concluded that the students performed moderately well for mechanics in the proximity of the mean (46.6%) and median (46%) scores obtained. Through the mean values of marks, it was identified that the "pressure" (21.2%) was the least scored component, and "Newton's laws" (70.6%) was the highest scored component in Mechanics. The student attitudes toward physics and the teacher's method of teaching were also identified as significant factors associated with the marks of the Mechanics section through regression analysis. The findings of this study are useful to those who design curricula as well as to the teachers and parents to upgrade students' performance in science.

Keywords: ANOVA, Mechanics, Performance of concepts, Regression analysis

CLUSTER ANALYSIS APPROACH TO IDENTIFY STUDENTS' ACADEMIC PERFORMANCE

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Today health, transportation, education, and agriculture are rapidly changing based on technology. Education in a country is a very important criterion of social and economic development. It differs in the success of educational institutions as well as the talents of the students. Assignments, quizzes, reports, practical exams, and final exams are used to measure the performance of the students in educational institutions. In addition, the students in education institutions engage in extracurricular activities. Their academic performance not only depends on academic activities but also on non-academic activities. Therefore, identifying the relationship between student performance and their other academic and non-academic activities is important. This study was conducted using students who have graduated from the Sabaragamuwa University of Sri Lanka in the last five years to identify the above relationships and the effects of other factors. After collecting data through Google form and selecting the top 10 attributes of the ranked dataset, the results are obtained using three clustering algorithms, namely, hierarchical clustering, simple k-means, and expectation maximum techniques, to cluster the students based on their final results. When comparing the original dataset and evaluation results obtained using the Weka data mining tool, the simple k-means clustering method has successfully grouped data with high accuracy, precision, recall, and f-measure values. Also, the mean squared error and root mean squared error values indicate the lowest error value of the simple k-means algorithm. The best result shown in the selected three clusters (First and Upper, Lower, Pass) are based on the final results obtained by the students for their degree. The evaluation results proved that there is a direct relationship between student performance and their activities and the simple k-means clustering algorithm showed the best result than the other two algorithms. We plan to continue this study using other factors that affected students' future goals and by increasing the dataset.

Keywords: Academic activities, Clustering, Machine learning, Non-academic activities, Students' performance

**FACTORS AFFECTING STUDENT PERFORMANCE IN SCIENCE AT THE
SECONDARY SCHOOL LEVEL: A CASE STUDY IN THE
KANDY EDUCATION ZONE, SRI LANKA**

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Even though many curriculum reforms have been introduced to Science Education in Sri Lanka, students' performance in G.C.E. (O/L) science has not significantly improved over the past several years. It is important to find out the factors that have not been addressed properly to improve the students' performance in science in the country. This study was designed to investigate the effect of self-concept, learning and teaching strategies, resources available in schools, and preferred topics in respective science curricula on students' performance. The study involved 170 students from Grades 6, 8, and 10 and also 15 teachers from three schools in the Kandy Education Zone. Questionnaires comprising closed-ended and open-ended questions were used to collect data. Students' preference for different topics in their respective science curricula was also assessed. Information about resources available for science education in schools and the teaching strategies were collected from teachers using a separate questionnaire. Term test marks were used to evaluate students' performance. The results of the study indicated a moderate, but significant positive correlation ($r = 0.5$, $p = 0.0001$) between students' self-concept and performance. Students from Grades 6 and 10 showed a considerable relationship between self-concept and science performance. However, the self-concept of Grade 8 students was weakly correlated to their performance ($r = 0.351$, $p = 0.129$), in that only 50% of them were positive about self-learning. According to data gathered, these schools have basic facilities (libraries, laboratories, and IT units), but not sufficient for the number of students in each school. It was identified that female students prefer biology-related topics (F: 65%; M: 15%) in the science curriculum while male students preferred physics-related topics (F: 10%; M: 35%). There was no difference in the preference between male and female students for chemistry-related topics (40%). This study identified the significant effect of the self-concept of students, teaching strategies, gender of students, available resources, and students' preference for science topics on their performance in science.

Keywords: G.C.E. (O/L) science, Learning and teaching strategies, Resources, Self-concept

**USE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN
TEACHING AND LEARNING OF BIOLOGY IN G.C.E ADVANCED LEVEL
CLASSES DURING COVID-19 PANDEMIC IN KOTHMALE EDUCATION ZONE**

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COVID-19 pandemic provided a huge opportunity for teachers and students to use Information and Communications Technology (ICT) for remote teaching and learning during school closures. The purpose of this study was to investigate how ICT was used in the teaching and learning of biology in G.C.E Advanced Level (A/L) classes in Sinhala medium schools of the Kothmale education zone in Sri Lanka during COVID-19. An online survey was carried out for the investigation to accomplish the objectives of finding (1) how ICT was used in teaching and learning biology, (2) for what purposes they were used, (3) whether they were still being used by the teachers and learners after reopening of schools and (4) to collect suggestions from teachers and students on what should be followed to promote the use of ICT in teaching and learning. Five biology teachers and 58 biology students of Grade 13 from five Sinhala medium 1AB schools were included in the sample. Data collected from two questionnaires for teachers and students was analysed quantitatively using descriptive statistics. The study revealed that the majority of teachers (80%) and students (89.6%) had used smartphones as the device, and 60% of teachers and 62% of students had used mobile data to connect to the teaching and learning process. Further, 60% of teachers and 56.9% of students had used multiple platforms such as WhatsApp and Zoom to connect to the teaching and learning process. Teachers used ICT to create and deliver lessons (100%), carry out assessments and evaluations (60%), send notes to students (60%) and to revise lessons (25%). In comparison, students joined to cover the lessons (68.9%), to revise lessons (15.5%), to obtain and share papers and notes (15.5%). The majority of teachers (60%) and students (68.9%) were still using ICT in teaching and learning after the schools had reopened. Providing facilities and training to teachers and students on ICT use and combining learning management systems were the common suggestions of teachers and students to promote the use of ICT in teaching and learning biology in A/L classes.

Keywords: Biology, COVID-19, ICT, Teaching and learning, School closures

**ENHANCEMENT OF STUDENTS' INTRINSIC MOTIVATION THROUGH
DIFFERENT TEACHING METHODS FOR GRADES 8 AND 9 SCIENCE: A CASE
STUDY IN SABARAGAMUWA PROVINCE, SRI LANKA**

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Science is a fundamental subject that focuses on meeting basic human needs. Thus, science education inflicts a universal impact on social and economic development. Intrinsic motivation initiates, directs, and maintains all behavioural responses of students related to education. Students with a good intrinsic motivation are always well-engaged, investigative, observant, and willing to participate in the learning process actively. This study aimed at investigating the effectiveness of different teaching methods to enhance students' intrinsic motivation in Grades 8 and 9 Science. A qualitative study was carried out with 1,232 students from Grades 8 and 9 classes in selected schools in Dehiowita and Kegalle Education Zones in Sabaragamuwa Province, Sri Lanka. Different teaching methods including discussions, debates, role plays, games, writing and speaking exercises, classroom assessments, group work, presentations, and practicals were used. In addition, strategies such as positive reinforcement, positive feedback, verbal rewards, good rapport, and two-way communication were also utilized. Continuous assessments were carried out and observations were noted during interventions. Focus group interviews were also conducted. A total of 38 focus group interviews were conducted in 19 selected schools with 5 to 7 student groups. Data were analysed using thematic and content analyses. Approximately 79% of students declared that they could face assessments more easily than earlier, while 76% of students noted that their achievement level improved remarkably. Five themes were derived using qualitative data such as attractive teaching-learning methods, rewards on intrinsic motivation, enhancement of students' retention power, facing assessments easily, and increase in achievement. The results confirmed that student-centred teaching-learning methods and strategies practiced in this study have enhanced Grades 8 and 9 student' intrinsic motivation. Hence, classroom practices have to be empowered through appropriate teaching-learning methods to enhance students' intrinsic motivation to create life-long learners.

Keywords: Interviews, Intrinsic motivation, Teaching methods

**EFFECT OF CONSTRUCTIVIST APPROACH IN TEACHING CHEMISTRY
LABORATORY EXPERIMENTS FOR DEVELOPING TEACHERS'
PEDAGOGICAL STRATEGIES**

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Pedagogical methods of teaching enhance students' recall capacity by recollecting the ideas that were taught to them even after a long gap. Constructivism is one of the most powerful pedagogical approaches in the classroom. The objective of this study was to investigate the use of the constructivist approach in chemistry laboratory experiments as a tool to develop teachers' pedagogical strategies for innovative teaching. For the development of three domains, a laboratory guide consisting of three chemistry laboratory lessons for each Grade 10 and 11 was developed with a constructivist approach. In the Grade 11 curriculum, Units on mixtures, solvents, and preparation of solutions; in the Grade 10 curriculum, Units on ionic and covalent compounds, types of chemical reactions, and reactivity of metals were selected. The three research questions were (1) What are the existing teaching methods used in conducting laboratory experiments? (2) What are the teachers' views on adopting a constructivist approach? and (3) What are the challenges teachers faced when they used the constructivist approach based-laboratory guide? A mixed-methods approach was used to find the answers to the above questions. The sample was 75 science teachers from five provinces. A questionnaire and semi-structured interview were used to gather information. The percentage values of closed questions in the survey questionnaire were used as quantitative data. Semi-structured interviews were scheduled, and open-ended questions were used to collect qualitative data and analysed using the Thematic analysis technique. Half of the teacher sample agreed that the constructivist approach used in laboratory practical work helped students to understand the chemistry concepts easily. In contrast, 30% and 20% of teachers preferred the existing teacher demonstration method and only explanation of the theory, respectively. Thematic analysis showed that teachers' participation in workshops and seminars is worthless unless the required resources in laboratories are fulfilled. The results of this study declared that chemistry laboratory experiments in the constructivist approach are helpful for the teachers to develop their pedagogical strategies.

Keywords: Chemistry laboratory, Constructivist approach, Pedagogical strategies, Science teachers

LABORATORY ACTIVITIES THROUGH A CONSTRUCTIVIST APPROACH FOR GRADE 10 STUDENTS' CHEMISTRY LEARNING

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Fundamentally, constructivism says that learner construct their understanding and knowledge of the world through experiencing things and reflecting on those experiences. The objectives of this study were to assess how the constructivist approach applied to the chemistry laboratory develops Grade 10 students' content knowledge, process skills, and attitudes towards learning chemistry. Hundred and sixty grade 10 students in the Vavuniya District were selected using the purposive sampling technique. A mixed methods approach was used. A questionnaire was administered to both experimental and control groups at the beginning of the study and at the end to evaluate the effectiveness of this study. Three chemistry laboratory lessons were developed using the constructivist approach. Each lesson consists of six approaches: pre-lab test to identify students' misconceptions, engaging activity to increase the cognitive ability of students, stepwise guidance introducing laboratory safety, recording sheet to develop students' reporting skills, and activity on day-to-day applications to utilize new conceptions in a wide range of contexts. The control group learned the lessons in the classroom traditionally, while the experimental group learned those while carrying out experiments in the laboratory using the newly prepared laboratory guide. At the end of each laboratory lesson, students' content knowledge was reassessed by a post-lab test. An achievement test was also administered to the experimental and control groups at the end of the entire study. During the implementation of the new laboratory guide, qualitative data were collected as photographs, videos, field notes, students' reflections, and semi-structured interviews with students and teachers. The p-values from the analyses of the results of pre-lab, post-lab, and achievement tests were less than a significant level of 0.05. This confirmed that the laboratory activities in the constructivist approach enhanced students' learning of chemistry. The analyses of questionnaire responses declared that the constructivist approach resulted in a 31% increase in student competency. The thematic analysis also confirmed it. It concludes that the laboratory activities in the constructivist approach enhanced students' learning of chemistry.

Keywords: Chemistry, Constructivist approach, Laboratory activities, Student competency

MODELLING THE CONCEPT IMAGE OF STUDENTS BASED ON A FORMAL STRUCTURE OF MATHEMATICAL CONCEPTS INCORPORATING LEARNING TAXONOMIES –A CASE STUDY

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Structuring concepts assist in identifying what relations exist between concepts and supports meaningful learning. A concept structure, which includes all the logical implications and manipulations related to a concept, can be modelled as a directed labelled graph incorporating Bloom's and SOLO taxonomies. In this model, the SOLO taxonomy levels are represented by the structure of the graphs, and various learning outcomes and their Bloom's levels are identified by arrows and labels. The main goal of this case study is to model and assess the concept image, the total cognitive structure associated with a concept, of an individual, related to the topic limits in calculus that comes in mathematics, based on the modelled concept structure. We show that such a representation of the concept image, when compared with the concept structure, enables the identification of learning deficiencies. Thus, these models can effectively assess and shape the pedagogy. The concept structure of the topic limit was developed to reflect what has been covered in the G.C.E. (A/L) Combined Mathematics curriculum. In order to model the concept image, the test subject (the student of interest) was given both a Word Association Test and a question index related to the concept limit. It was noticed that the Word Association technique can only capture a limited structure and fails to identify the directionality of the relations between concepts. The question index provided a more realistic model of the concept image of the test subject. Using this method, we identified existing and missing concepts in the student's concept image and misconceptions that exist in the cognitive structure. The incorporation of learning taxonomies provides a direct way to use these models in assessment and the teaching-learning process.

Keywords: Cognitive structure, Concept structure, Concept image, Learning taxonomies, Word association test

21ST CENTURY STEM EDUCATION: TEACHER COMPETENCY IN CLASSROOM PRACTICES

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STEM is an acronym, and it is a pedagogical approach, used internationally to create human resources for the job market. This acronym stands for Science, Technology, Engineering, and Mathematics and it provides an opportunity to produce citizens with critical thinking to face the competitive economy of today's world. In a developing country like Sri Lanka, the introduction of STEM education is a successful alternative to solve economic and social problems. This study aims to understand teacher competencies to implement STEM activities in junior secondary science classrooms. Multiple case study design was used in this research. Data were collected from three in-service science teachers who teach in Grade 6 in Ampara education zone through in-depth interviews, observations, and documents. Data were analysed using thematic analysis and four major themes were identified: teachers' knowledge of STEM disciplines, teachers' skills in the use of ICT, pedagogical practices in classrooms, and teacher competence in using international language. Findings revealed that teachers' knowledge of STEM disciplines varied in three cases and graduate teacher is more confident in four disciplines. Cross analysis of cases showed that the teacher with a diploma in teaching was competent with pedagogical practices required for STEM education. The untrained young teacher had skills in the use of ICT for STEM teaching. In addition, all three cases did not possess the required skills in an international language. The study shows that teacher competencies in STEM education depend on teachers' qualifications and that teachers were not well equipped to teach STEM disciplines. Therefore, teacher competencies should be enhanced through professional development programs before introducing STEM education to the junior secondary stage of education.

Keywords: STEM education, Teacher competencies, Teacher professional development

CURRENT STATUS OF THE STEM-RELATED ACTIVITIES IN PRIMARY EDUCATION IN SRI LANKA

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STEM education is the integration of Science, Technology, Engineering, and Mathematics which creates a student-centred learning environment in classrooms. Activity-based STEM modules have been introduced to primary grades in many countries and reported the effectiveness. In Sri Lanka Environment Related Activity (ERA) curricula for Grades 3, 4, and 5 are designed with activity-based course modules, however, STEM concepts have not been fully implemented in primary-level education in the country. The objective of the current study is to explore the existing STEM-related activities in primary grade curricula and the perception and awareness of primary level teachers on STEM-related activities. Teacher perception and awareness of STEM-related activities in the present curricula of Grades 3, 4, and 5 were assessed via a questionnaire. Classroom-based observations were done for 32 lessons of ERA STEM-related activities. Thematic and content analysis was used to analyse observations and documents. Sixteen themes were identified for the study. Analysis revealed that 127, 134, and 148 activities are available in ERA curricula of grades 3, 4, and 5 respectively. STEM-related activities were present in 41%, 28%, and 25% of course modules in grades 3, 4, and 5 respectively. Out of the 16 themes, three themes were about plants, water, and garden with a significant amount of STEM activities. Outcomes of the teachers' questionnaire revealed that 73.33% of the teachers do not have sufficient knowledge about STEM concepts. Most of the primary teachers in the sample (95%) were not science graduates and showed minimal knowledge to conduct STEM activities and the lesson plans developed by them were not satisfactory. Awareness and teacher training programs are crucial in implementing the STEM-based, teaching-learning process in primary education in Sri Lanka.

Keywords: Activity-based teaching, Primary level education, STEM education

JUNIOR SECONDARY SCIENCE TEACHERS' AWARENESS OF SCIENCE PROCESS SKILLS

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Science Process Skills (SPS) is one of the important aspects that any individual should acquire in learning science. Teachers, when teaching science, must be able to appropriately integrate SPS and science content so that students obtain SPS adequately. Thus, science teachers must necessarily be well versed in both SPS and science content. Accordingly, this research was focused on investigating the awareness of SPS in junior secondary science teachers in Kegalle Education Zone, Sri Lanka. The main objective of this study was to find out how far junior secondary science teachers are aware of SPS and their conceptual understanding of SPS. A convenient sampling method was used to select 35 junior secondary science teachers from nine schools in Kegalle Education Zone. The Mixed methods approach and convenient parallel design were used. Quantitative data were collected using a Google Form questionnaire and analysed for both descriptive and inferential statistics using IBM SPSS Statistics 22.0 software and MS Excel. Qualitative data were collected through both semi-structured interviews and questionnaires and analysed using the Thematic Analysis technique. Quantitative results indicated that 60% of the teachers were aware of the term "Science Process Skills". There was a significant association between the awareness of the term SPS and professional qualifications (chi-square = 6.242, df = 2, p < 0.05). Teachers' conceptual understanding of SPS was at a medium level (63.26%). There was a significant difference between the conceptual understanding of basic SPS and integrated SPS ($t(35) = 3.727$, p < 0.05). The conceptual understanding of integrated SPS (51.43 ± 25.68) was significantly lower than that of the basic SPS (72.14 ± 13.59). There was no significant association obtained between the level of conceptual understanding and age, seniority, educational qualification, school type, medium of instruction, or professional qualification. In the semi-structured interviews, statements collected from two of the four teachers indicated that they were aware of the term SPS while the other two indicated that they were unaware of the term SPS. Only one teacher provided a true description of SPS, and two teachers provided partially true descriptions. The other teacher provided a false description of SPS. Thus, the understanding of SPS among junior secondary science teachers is at an average level and it is expected to further improve their understanding and knowledge of SPS independently or through professional career development and training programs.

Keywords: Basic SPS, Integrated SPS, Junior secondary teacher, Science process skills

PERCEPTION OF GRADE 10 STUDENTS ON SCIENCE PRACTICAL COMPONENT AND LABORATORY EXPERIENCE: A CASE STUDY IN KEGALLE EDUCATION ZONE

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The performance of the science subject at the secondary school level in Sri Lanka is challenging due to the complexity and the content of the syllabus. The main goal of the present study was to determine the perception of Grade 10 students towards laboratory-based practicals and to reveal the problems faced by them due to limited laboratory facilities available in schools. A survey was conducted using a questionnaire for a sample of 184 randomly selected Grade 10 students from six schools (two from each: 1 AB, C, and Type 2) in Kegalle District. Details on the practical component that have been already covered and laboratory facilities available in each school were also collected. Nearly 89% of students from all schools stated that the practical component has helped them to properly understand the subject. Compared to type C and Type 2 schools, 1AB schools had almost all the laboratory facilities. However, type 1AB schools had covered only 20-50% of the practical component. Nearly 70% of these students were not satisfied with teachers' involvement in laboratory sessions. Even with fewer facilities, type C schools have covered nearly 88% of the practical component and these students were highly satisfied (98%) with the practical coverage. A relatively high percentage of students from type C schools (79%) stated that they could perform well in science due to the effective laboratory classes. More than 85% of the type C school students agreed that their teachers encourage them to participate in laboratory classes. More than 70% of the students of Type 2 schools did not have a clear view of the effect of laboratory experience on their performance. There is no significant difference between male and female students' views about laboratory components ($p > 0.05$). Overall, the results conclude that teachers' opinions and student numbers in classes affect the success of laboratory sessions despite the available resources. Therefore, it could be suggested to conduct more training sessions for teachers to provide a better laboratory experience to students even if the classes are crowded.

Keywords: Kegalle education zone, Practical component, Science, Secondary school

ISSUES IN IMPLEMENTING THE CURRICULUM OF TECHNOLOGY STREAM IN SCHOOLS

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This study was carried out to explore issues in conducting the curriculum of technology stream in schools. Since its implementation about six years ago, there are still unresolved problems faced by teachers and students. The study was carried out in Kuliyaipitiya Education Zone. The objectives identified for this study are to, examine current practices related to the technology stream, identify issues that students are facing in learning the Technology stream, identify issues that teachers are facing in teaching the curriculum, and gather suggestions to enhance the quality of implementing the technology stream in Sri Lankan schools. In this study, a mixed methods approach and convergent parallel mixed method design was used. Forty students and 12 Teachers from four schools that conduct technology stream in Kuliyaipitiya Education Zone were selected. Data collection was conducted quantitatively through questionnaires and qualitatively through interviews. Questionnaires were provided to students and semi-structured interviews were conducted with teachers. Qualitative data analysis was carried out through thematic analysis and quantitative data analysis using MS Excel software. Several implementation practices were identified and were categorized under the selection of students, assessment and evaluation, motivation, monitoring of the aching-learning process, availability of physical resources in schools, recruitment and training of teachers, and nature of the syllabus. Inadequate resources and lack of basic mathematical skills among students were identified as major problems faced by students. Insufficient training, insufficient resources for teaching, students' low attendance, and drawbacks in the student selection procedure were identified as major problems faced by teachers. According to teachers and students, providing sufficient resources to conduct experiments, conducting more practical sessions and providing a sufficient number of qualified teachers, increasing minimum requirements for student selection, encouraging student attendance, and providing proper teacher training are some of the suggestions to mitigate these issues. The authorities are needed to take necessary action to resolve these issues and to successfully implement this major subject stream in the education system in Sri Lanka.

Keywords: Curriculum, Mathematical skills, Resources, Technology stream

STEM INTEGRATION INTO THE PRIMARY STAGE OF EDUCATION

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STEM is an acronym used for Science, Technology, Engineering, and Mathematics and is a recent global educational approach to produce capable citizens to face the demands of the 21st century. Having identified the importance of STEM education, it has been introduced to the formal education system in many countries. The purpose of this study is to find out the possibility of integrating STEM into the existing primary curriculum through Environment Related Activities (ERA). Sequential explanatory design of the mixed method research approach was used in this study and data were collected with the use of a survey questionnaire, focus group interviews, observations, documents, and teachers' reflective notes. Data obtained from the questionnaire were analysed quantitatively while the rest of the data was analysed qualitatively using thematic analysis. The findings of the study revealed that only 19% of teachers have heard of STEM through the workshops conducted by the teacher centres. Out of them, only 4% stated correctly the four disciplines identified in the STEM concept. The responses obtained from teachers further indicated that 92% of them were familiar with the concept of integration which is considered a key characteristic of STEM. Analysis of teacher reflections revealed that STEM can be easily integrated into ERA lessons and it can provide students with numerous opportunities to enhance their skills needed for the future world of work. Therefore, steps should be taken to formally introduce STEM education to the primary curriculum through the subject ERA. To implement STEM into the primary curriculum, teachers should be properly trained on STEM education and how it can integrate into the primary curriculum through ERA.

Financial assistance from University of Peradeniya (URG /2019/40/A) is acknowledged.

Keywords: Curriculum, ERA, Primary, STEM

**ONLINE EDUCATION EXPERIENCES OF BIOLOGY TEACHERS DURING
COVID-19 EPIDEMIC IN THREE DISTRICTS IN
SRI LANKA: PHENOMENOLOGICAL ANALYSIS**

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The Covid-19 epidemic had a profound effect on the conventional education systems around the world. This study aims to investigate biology teachers' online education experiences during the Covid-19 epidemic period in three districts in Sri Lanka. This study used the phenomenological design methodology under qualitative research methods. Participants were selected using the purposive sampling method and included 106 Biology teachers (69 females and 37 males) working in government schools in Anuradhapura, Kurunegala and Colombo districts during the academic year 2021–2022. The participants voluntarily provided data for the study and did not use real identities to protect the confidentiality of the data. Data were collected through questionnaires, and then interviews were conducted on the validations built through the questionnaires. The data were analysed through thematic and content analysis. Results show that 54% of teachers experienced communication breakdowns during the lessons. Only 43% of the students had access to online education due to socio-economic issues. Moreover, 41% of students were interrupted in the home environment due to poor internet connections, whereas 32% of teachers did not have a good internet connection at their residences. Further, 28% of teachers claimed that delivering biology practical lessons and diagrams was difficult. Regardless of the nature of their experience of hardships, this study has revealed that teachers were able to continue education during the Covid-19 epidemic professionally. Hence, it is necessary to facilitate the online teaching and learning process to enhance students' meaningful learning.

Keywords: Biology teachers, Covid-19, Online education, Online teaching, Phenomenology

DEVELOPING RESEARCH SKILLS THROUGH SCIENTIFIC APPROACH IN UPPER SECONDARY LEVEL STUDENTS: A CASE STUDY IN KURUNEGALA EDUCATION ZONE, SRI LANKA

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It is well accepted that the opportunities to develop research skills should be started at the school level. The skill of conducting research is an extremely useful life skill and in foreign countries, research skills have been integrated into their formal school curriculum. However, in the Sri Lankan school context, the school curriculum does not provide an opportunity to develop students' research skills. Thus, this study focused to develop research skills among upper secondary level students in Grades 10 to 13 providing opportunities to identify the research problem, write a research proposal, and conduct research. Mixed methods research approach was followed. Purposive sampling technique was used to select 112 students from IAB national school in Kurunegala education zone. Qualitative data were collected mainly by observations and interviews which were analysed using thematic analysis. A questionnaire was used to collect students' views on conducting research. The survey data were analysed using descriptive statistics. According to the views of students, 99% of students were interested in research. Around 96% and 98% of students mentioned that conducting research helps their studies and develop their soft skills respectively. However, 68% of students mentioned that conducting research is difficult with their studies. According to qualitative data, students engaged in activities of developing research skills enthusiastically and they were innovative and initiative. Some reinforcement like prizes, medals, and certificates can be used to motivate students in researching. Workshops, seminars, online meetings, group discussions, and conducting competitions were used effectively to develop the research skills of upper secondary level students.

Keywords: Developing research skills, Research skills, Upper secondary level students

IMPROVING SOLVING SKILLS OF WORD PROBLEMS BY ELIMINATING DIFFICULTIES ENCOUNTERED IN FRACTIONAL NUMBERS

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The concept of fractional numbers in mathematics which is essential to learning most other mathematical concepts is introduced in Grade 3 of the mathematics curriculum in Sri Lanka. This expands gradually in each Grade and reaches the fractional numbers in word problems in Grade 10. It was observed that most students find it difficult to work with word problems involving fractions in Grade 10. Therefore, this experimental research was carried out to evaluate the relationship between the method illustrated in the recommended textbook and “Branch System” instruction introduced by this study to increase the achievements in this section. The Branch System was utilized for the experimental group while recommended textbook instruction was used with the control group over two weeks in preparation for a post-test. Additionally, classroom observations and unstructured interviews with mathematics teachers were conducted. This research used mixed methods of study and SPSS statistical software and thematic analysis were used for data analysis. This study tested the hypothesis utilizing an independent Mann-Whitney U test. According to the findings, the achievement of the group who received Branch System instructions (Median = 68.00) was higher than the group who received recommended textbook instructions (Median = 40.75); the experimental group worked out steadily for a less period of time; subsequent parts of the problems were solved easily: the branch system instruction was straight forward. Although the above-average students performed well in both methods, average and below-average students in the experimental group relatively scored more. Generally, Branch System instruction helped to improve students’ learning of fractional numbers in word problems. This experimental study was carried out with a sample size of 40 students in a selected school, but this study can be generalized by considering a larger sample including many schools.

Keywords: Branch system, Fractional numbers, Mann-Whitney U test, Mathematics curriculum

TEACHERS' PERSPECTIVES ON AUTHENTICATING CHEMISTRY LEARNING AND TEACHING WITH ENVIRONMENT-BASED ACTIVITIES

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Authentic learning is an instructional approach that allows students to explore, discuss, and meaningfully construct concepts and relationships in contexts that involve real-world problems, which are relevant to the learner. This paper is mainly focused on the teachers' views towards authenticating environment-based activities to teach environment-related chemistry topics in Grade 3 to General Certificate of Education (G.C.E.) Advanced Level syllabi in Sri Lankan education context. Before designing and implementing activities, teachers' views towards this approach were checked by administering questionnaires. To collect data, teachers' samples were selected from the Western province. Semi-structured questionnaires were administered among selected teachers to obtain their views. Teachers' responses were analysed quantitatively using SPSS (Statistical Package for Social Science) software. Teachers' responses showed that the majority of primary teachers (67%) were of applying environment-based activities in the teaching-learning process while the others have less experience. Teachers were on the view of authenticating topics related to water (80%), air (57%), soil (65%), environmental chemistry (46%), and industrial applications (45%) with environment-based activities in different environments. Heavy syllabus (73%) and exam-oriented practices (83%) were the main problems identified by teachers in applying the proposed approach and it was suggested to reduce the syllabi and change the pattern of the examinations. In general, 60% of teachers prefer to authenticate chemistry teaching and learning with environment-based activities for developing knowledge, attitudes, and skills in students.

Keywords: Authentic learning, Environment-based activities, Teachers' perspectives

TRADITIONAL TEACHING AND ASSESSMENT VERSUS SKILL-ORIENTED INSTRUCTION AND ASSESSMENT TO ENHANCE GENERIC SKILLS IN LEARNING CHEMISTRY IN JUNIOR SECONDARY SCHOOL

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In the teaching-learning process, assessments have become an important topic of discussion. It is crucial to revisit the instructional and assessment systems in the 21st century perspectives as they demand real-world learning with skills as learning outcomes. This research examines the effectiveness of traditional teaching and assessment versus skills-oriented instruction and assessment in enhancing generic skills in learning Chemistry in junior secondary schools in Sri Lanka. This is an experimental study that employed mixed methods. Two subunits from Grade 7 science curricula were selected for instruction. Two parallel classes of Grade 7 from the same school in Matale, Sri Lanka, were selected. A Pre-test was administered to both classes to ensure comparability of the groups. One class was used as a control group and the other class as an experimental group. In the 2nd sub-unit, these groups were interchanged. The first lesson was conducted by the traditional method for the control group and experimental group by the skill-oriented instructional and assessment method, in the second lesson the parallel classes were switched over, for instruction, and the same teachers were employed. After the teaching-learning process post-tests were administered to both groups for both lessons. While doing both traditional and skill-oriented learning, generic skills were observed by the researcher with the help of three other teachers using scoring rubrics. The differences between the mean scores of pre-tests, post-tests, and generic skill tests were compared. According to the results, skill-oriented groups' learning achievements were significantly better in performance than the conventional group. Furthermore, the observational data analysis demonstrated that the students of the skill-oriented instructional group demonstrated better orientation to real-life situations and the 21st century. Findings of the focus group discussions revealed that both students and teachers agreed to skill-oriented instruction and assessment cultivate much higher generic skills. Overall, the result of the study revealed that the skill-oriented instruction and assessment methods could be successfully applied for conceptual understanding of lessons and the development of generic skills among students of Grade 7.

Keywords: Focus group discussion, Generic skills, Scoring rubrics, Skill-oriented, Traditional instruction

**APPLICATION OF AUTHENTIC INSTRUCTION AND ASSESSMENT IN
THEMATIC LEARNING SCIENCE IN JUNIOR SECONDARY SCHOOLS IN SRI
LANKA: A PILOT STUDY**

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Today, theme-based learning is gaining ground. Twenty-First Century Learning Frameworks in developed countries are also exploring skills-oriented learning outcomes. According to past studies, science teachers prefer theme-based Authentic Instruction and Assessment (AIA) to bring about expected learning outcomes. Further, skilled labour with scientific attitudes is much needed for the economic development of a country. Hence, this study aims at ascertaining the skills-oriented learning outcomes by applying AIA in Thematic Learning using learning modules. The content and the context of science textbooks (Grades 6-8), relevant Teacher Instructional Manuals (TIMs), and test papers were analysed. Focused group discussions were carried out with the participation of experienced science teachers to identify macro and micro-themes, their horizontal and vertical integration, and the prevailing assessment system in schools. Four modules were prepared without losing content in current science textbooks for Grades 6, 7, and 8 on two selected micro themes *viz.*, changes in the environment and microorganisms, based on skills-oriented learning activities related to real-life situations. Authentic assessments were also designed to measure students' skills-oriented learning outcomes using rubrics. The modules were tested with 20 students in relevant grades to observe the flow of activities and their attitudes about the new approach. From each grade, 10 randomly selected students and their teachers were interviewed. Students mentioned that they could collaboratively engage in interesting activities in and outside the classroom and at home. Teachers revealed that activities and authentic tasks created opportunities for self-learning, as they are skill-based. Moreover, the teachers accepted the rubrics as a smart tool for measuring students' skills. Following thematic analysis, the results revealed that a majority of teachers and students (90% and 100%, respectively) showed their willingness to use modules in place of textbooks. Thus, the use of theme-based learning modules in the teaching of junior secondary school science seems a better approach than the current practice.

Keywords: Authentic assessment, Authentic instruction, Thematic learning

**SCHOOL-BASED ASSESSMENT SYSTEM IN G.C.E. ADVANCED LEVEL
CHEMISTRY IN SRI LANKA**

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The School-Based Assessment (SBA) system was introduced for the General Certificate of Education (G.C.E.) Advanced Level (A/L) students under the circular number 2008/06 by the Ministry of Education, Sri Lanka. The only goal of the teaching and learning process in G.C.E (A/L) classes has now become "scoring at the final examination". Conducting of SBA becomes meaningless in this scenario as those marks carry no value in the final examination. In this environment, only 40-50% of total candidates get through the G.C.E (A/L) examination and, among them, 10% become eligible for university entrance. The existing system, which was not changed during the past few decades, has drastically affected the socio-economic development of the country. The objective of this study is to evaluate the importance and identify the pros and cons of the existing SBA system in G.C.E (A/L) classes as per the views and perceptions of students and teachers as applied to chemistry. Qualitative and quantitative data collection has been done by focused group discussions, analysing reports published by the Department of Examinations (DOE), research publications, scheduled semi-structured interviews, and questionnaires. Focus group discussions have been conducted with a sample of eight teachers and twenty-eight students from five schools including both national and provincial schools in three provinces. Analysis of the results shows that SBA is conducted only in 68.4% of the schools while others are sending fabricated marks to the DOE. Only 68.8% of the students agreed with the opinion that a "teacher's attempt to conduct SBA is successful" while only 33.5% of the teachers agreed with that the existing SBA system is successful and useful for students. The thematic data analysis technique was utilized to build an informative picture of SBA. For this purpose, initially identified 128 codes were refined to 40 final codes, and by further refining to twenty-one sub-themes, a "final picture" could be built with the seven themes obtained after final refining. Both students and teachers have requested a more student-teacher friendly, reliable, and consistent SBA system which has a definite value at the final examination.

Keywords: Quantitative, Qualitative, School-based assessment, Thematic analysis

**CASE STUDY ON USE OF JUNIOR SCIENCE LABORATORIES
BY GRADE 9 STUDENTS IN KANDY EDUCATION ZONE**

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The Science curriculum at the junior secondary level in Sri Lanka provides the students with opportunities to practice the processes of investigation in authentic contexts. The main objective of this research was to study the use of junior science laboratories by grade 9 students in schools in the Kandy Education Zone. This research was carried out using a multiple case study design. Three science teachers and twelve students from three mixed schools representing: 1AB, 1C, and Type 2 schools (3 cases) were used as research participants. Semi-structured interviews, observations, documentary data, and questionnaires were used for collecting data. Data were analysed thematically, and cases were cross-compared to arrive at conclusions. Findings revealed that teachers in type 1AB and 1C schools conducted practicals as demonstrations whereas teachers in type 2 schools provided hands-on-activities. A larger number of students in a classroom, less time allocation for practicals, and lack of resources were common problems in both 1AB and 1C schools. Non-availability of laboratory assistants and the overloaded syllabus were common problems in all three schools. It was also evident that the engagement of male students was comparatively higher than female students in practicals. It can be concluded that both type 1AB and type 1C schools do not have enough resources and classes were overcrowded. So the students have less opportunity to participate in science practical activities as type 2 schools do. Also, there was no gender base difference in participating in science practical activities. It is recommended that junior science laboratories could be used more effectively for science teaching, by providing necessary resources and facilities and by allocating more time for practicals. This study could be further improved using a larger sample.

Keywords: Case study, Junior science laboratories, Junior secondary level, Laboratory practicals

A CASE STUDY ON THE APPLICATION OF THREE-DIMENSIONAL LEARNING METHOD TO TEACH SCIENCE CURRICULUM IN GALEWELA EDUCATION ZONE, SRI LANKA

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The Next Generation Science Standards introduced the three-dimensional learning method (3DL) in the United States of America in 2013. The three dimensions are science and engineering practices, crosscutting concepts, and disciplinary core ideas. The three dimensions are aligned to integrate and explain phenomena and design solutions to problems to drive student learning. This study aimed to find the effect of the 3DL method comparatively to the 5E learning method on low, medium, and high-performing students. A quantitative research method was carried out with 88 students in the Galewela Education Zone, Sri Lanka. The purposive sampling technique was used to collect the data. The students were grouped into performance levels (low, medium, and high performers) using a pre-test and they were divided into a control group and an experimental group. The experimental group received instruction using the 3DL-aligned 5E learning method, while the control group received instruction using the 5E learning method only. On the completion of the intervention, post-tests were administered to both groups. The results were analysed using paired t-tests, and independent t-tests using IBM SPSS Statistics version 22.0 for Windows. Even though the pre-test scores of both groups were equal at the beginning, there was a statistically significant difference in the post-test scores in the experimental group compared to the control group ($p < 0.001$). Due to the significant increase in post-test scores of the experimental group, the 3DL method showed a positive effect on student performance. Furthermore, low- and medium-performing students improve their learning with the 3DL method. Other science lessons in Grades 10 and 11 can also be taught using the 3DL method for further studies; chemical bonds (Grade 10 science) and heat change associated with a chemical reaction (Grade 11).

Keywords: Cross-cutting concepts, Disciplinary core ideas, Science and engineering practices, Three-Dimensional learning method

**IMPACT OF STUDENTS' PERFORMANCE AND ASPIRATION BY MOTIVATION
IN MATHEMATICS LEARNING WITH SELF-DETERMINATION THEORY**

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Self-determination theory, a theory of human motivation, suggests that people can be self-determined when their needs for competence, relatedness, and autonomy are fulfilled. When it comes to education, it emphasizes teaching approach should be student-centred learning while the teacher becomes a facilitator. This method is different from the traditional teacher-centred method, which is meant to be more effective in improving student engagement in mathematics. The aim of this study is to develop a relation between Self-determination theory and students' motivation, aspiration, and performance in contrast to the traditional teaching method. True experimental research design and the convenience sampling method were used to select three schools in the Hatton education zone. The sample consisted of 80 Grade 10 students and five mathematics teachers from three schools. Data collection was conducted through questionnaires, semi-structured interview schedules, and question papers. Quantitative data were analysed using SPSS 17.0 and qualitative data were analysed using thematic analysis. The lesson unit selected for the study is perimeter including the length and perimeter of a sector of a circle. Two homogeneous samples were identified as control and experimental groups through a pre-test which was used to explore students' prior knowledge. Prior to the intervention, a questionnaire was administered to both groups to investigate the motivation and aspirations of students. The experimental group was instructed according to the aspects of self-determination theory and the traditional method was used for the control group. Students' performance, motivation, and aspiration were examined in both groups after the intervention. Regression analysis was used to compute the relation between the variables. According to the results, the effect size between motivation and performance was 26.4% while it was 36.8% between motivation and aspirations. Thus, there is a strong impact on students' performance and aspirations by motivation. Hence, it is suggested that the present classroom teaching strategies have to be changed into a student-centred approach with the use of aspects of Self-determination theory.

Keywords: Self-determination theory, Student-Centred Teaching

INFLUENCE OF FACEBOOK USAGE ON THE ACADEMIC PERFORMANCE OF GRADE 11 STUDENTS IN THE MAWANELLA EDUCATION ZONE

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Today's teens are referred to as "digital natives", and they are intimately linked to technology. They quickly pick up new technologies and seek new ways to interact and make new friends. For this, social media platform plays a significant role in modern society. Facebook is the most popular social media site among Sri Lankan youth, and studies conducted in the higher education sector have revealed that it has positive as well as negative effects on their academic performance. This study investigated whether there is a significant impact on students' academic performance related to Facebook and internet usage in the Mawanella Education Zone. Four schools (1AB, Type 2, and two schools from the Type C) and 200 students were selected using a convenience sampling technique. Data were collected using questionnaires. Total marks for nine subjects and science marks of the students were considered academic performance indicators. Data were analysed using regression, Chi-squared test using PAST (version 4) statistical software. Results revealed that the time spent on the internet did not depend on gender. However, time spent on Facebook varied with gender significantly ($p < 0.05$) with male students using more surfing time than female students. Further, regression analysis was conducted to examine the relationships between student performance and total study time, Facebook and internet surfing time, and Facebook usage frequency. There was a significant positive linear relationship between students' science marks and internet surfing time ($p < 0.05$). No significant relationship was observed between students' science marks and students' total marks with Facebook surfing time and the frequency they use it. It can be concluded that there was a significant impact on internet usage on students' science performance, but no influence on Facebook usage on their performance. These findings would be important for further studies as well as for policymakers in the education system to empower students' meaningful learning.

Keywords: Facebook, Internet, Performance, Science

PROBLEM-BASED LEARNING FOR THE ENHANCEMENT OF TEACHING-LEARNING PROCESS OF INDUSTRIAL CHEMISTRY IN G.C.E. (A/L): A CASE STUDY IN GALLE EDUCATION ZONE, SRI LANKA

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Problem-based learning (PBL) is an innovative psychological approach that enhances the in-depth study of the subject matter incorporated with real-world applications. PBL involves interdisciplinary learning and collaborative efforts, spreading beyond the boundaries of traditional teaching-learning systems. This study aimed to evaluate the efficiency of PBL over traditional teaching methods based on the study of the Industrial Chemistry unit in General Certificate of Education (G.C.E.) Advanced Level (A/L) Chemistry. As participants, 82 Grade 13 science students, who follow Chemistry as one of the subjects, from a 1AB school in Galle Educational Zone were selected through the purposive sampling technique. The selected students underwent a pre-test as a preliminary assessment which was based on the first two cognitive levels of Bloom's Taxonomy. Next, the students were divided into two similar groups (experimental and control) based on the marks obtained in the pre-test. The effectiveness of the teaching techniques was evaluated by two post-tests which were based on the first four cognitive levels of Bloom's Taxonomy. It was observed that 70% increase in the average marks of two post-tests compared to the pre-test marks of the experimental group while the respective increment of the control group is 41%. The results of the two post-tests showed that the effectiveness of the PBL approach has continued growth in student performance over time. Thus, it can be concluded that PBL is more effective than the traditional teaching method resulting in the continued growth of knowledge acquisition and retention. Hence, chemistry classroom practices must be re-evaluated to facilitate meaningful learning of the students to empower and enhance their level of achievement.

Keywords: G.C.E. (A/L) chemistry, Industrial chemistry, Problem-Based Learning (PBL)

DEVELOPING INFORMATION COMMUNICATION SKILLS TO ADAPT TO VIRTUAL TEACHING: AN ACTION RESEARCH IN A NATIONAL COLLEGE OF EDUCATION, SRI LANKA

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The rapidly changing environment of the global context has led many sectors and industries to technology-driven platforms. Each sector has its own value additions to the economy as well as the society in various manners. Among those, the education sector could be identified as a vital sector as it provides huge benefits not only to society but also to the economy of the country. In the current context, e-learning is emerging as the newest practice in modern education. When the COVID-19 pandemic hits the world, almost all the activities were shifted to the virtual platform. The education sector was also impacted by the current pandemic situation. National colleges of education (NCoE) were closed and taken as Covid treatment centres. Consequently, online learning emerged as the new normal lifestyle in the education sector. Thus, the aim of this study was to develop Information Communication Skills to adapt to virtual teaching by empowering lecturers in NCoEs for effective practices. This is action research accomplished with the lecturers of Dambadeniya Sariputta NCoE. A sample of 28 lecturers and 96 prospective teachers were selected. Data were collected through questionnaires, observations, documentation, and interviews. During the intervention process, the use of different online platforms such as MS-teams, Zoom, Google classroom, WhatsApp, and other online apps were implemented and practiced. At the end of the intervention process, perceptions were gathered from lecturers and prospective teachers. Quantitative data were analysed using MS-Excel and qualitative data were analysed using the thematic analysis technique. The findings of this study indicated an increase in ICT usage by lecturers, enhancement of enthusiasm in prospective teachers, and development of motivation with both lecturers and prospective teachers in different virtual platforms supported in enhancing their information communication skills. Further, it was found that participation in online lessons by prospective teachers was increased by 32.5% while marks on the assignments were enhanced by 48%. The preference for conducting online lessons by lecturers was also improved by 26%. Thus, it is suggested to empower the lecturers and prospective teachers of NCoEs with modern ICT applications to enhance their level of satisfaction and motivation to use ICT in the teaching-learning process to facilitate meaningful learning.

Keywords: Information Communication Technology, Social media, Virtual teaching, Virtual platforms, Virtual apps

INNOVATIONS EMERGED DURING COVID PANDEMIC LOCKDOWN: A CASE STUDY

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Schools were shut down due to the Covid 19 pandemic situation in Sri Lanka for more than two years and children had no schooling, and this paper highlights the endeavour by reflecting upon the experiences of an 11-year-old boy who started exploring new innovations during the closure of schools for 8 months. Having developed an incubator for fun, ended up with an all-island final round selection for "Young Inventions for Better Tomorrow 2022, under the age category of 11 years from the 7500 entries. Research on interventions with parental involvement reveals many approaches for new findings addressing the following three objectives of directing a child to use the time fruitfully while setting goals for entrepreneurship from the early stage will lead to opportunities for a patent. The innovation was developed from manual to automatic control of humidity, temperature, and turning of the eggs till the chicks come out using an Arduino program, whereas initiatively, observations, and discussions revealed that the inquisitive mind can be stimulated through parental scaffolding and underpinning as facilitators since it has a vast impact on boosting hibernated young minds to become innovators. In such a scenario, despite evidence that girls outperform boys in educational achievements, the general perception is that boys are naturally smarter in skills and application. Analysis of all these facts arises whether the present system of education addresses the job market and the trend of new innovations satisfactorily for a higher level of achievements as an issue of both equity and human capital: talented students deserve befitting resources and tend, and it is required to develop these students' abilities to persist competitive in the international sphere. His entrepreneur initiatives in hatching chicks at a macro level using low-cost materials will be one of the best outcomes of manual to digital control using the Arduino Uno board to introduce it to the farmers for hatching eggs at the macro level and to breed immigrant and extinct birds at sanctuaries, supporting education in developing the economy of the country. This study contributes to the body of literature in several dimensions influencing the appraisal of innovative studies among secondary school students to promote an innovative culture within the future generation, curriculum designers and policymakers should deliberate promoting innovative culture in Sri Lanka including subjects like ICT, AI, 3D printing to the curricula.

Keywords: Covid pandemic homestay, Entrepreneurship, Innovations

EXISTING ICT SKILLS OF PROSPECTIVE TEACHERS IN THE NATIONAL COLLEGES OF EDUCATION

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The literacy skills of ICT of prospective teachers are useful for their academic purposes as well as in their professions as teachers in the future. This study brings attention to the determinants of 21st century ICT skills of ICT prospective teachers at National Colleges of Education (NCoE). In 2001, a group of ICT experts called the International ICT panel invented a literacy model called the 21st century ICT Literacy Model. ICT competency highly considers enhancing certain cognitive skills for managing, integrating, and evaluating information. This study was focused on measuring the ICT skills of prospective teachers of three National Colleges of Education. The objective of this study was to identify the level of ICT skills among prospective teachers in the domain of Accessing, Managing and Creating, Integrating, and Communication and find out the constraints encountered by prospective teachers in learning ICT. A survey design was used in the study. A questionnaire prepared using Google form was used as a research instrument. The data obtained from 300 prospective teachers selected purposively, who submitted complete answers to the questionnaire were analysed quantitatively using the SPSS (version 25) statistical software. The items of the questionnaire consisted of Managing, Accessing, Integrating, Communicating, and Creating. Out of these five domains, only the domain of Integrating was selected for the study. It consists of four items, and each item contains 5 responses. Their means were 2.84, 2.14, 2.12, and 2.37 respectively. Medians were 3, 2, 2, and 2. Modes were 3, 1, 2, and 2 respectively. The result of this study revealed that 28.9% of participants were in the level of somewhat skilled, 26.3% of participants were in the level of skilled, and 22.6% of participants were in the level of not very skilled. However, 14.2% of participants were in the level of highly skilled and 7.9% of participants were in the level of not at all skilled. The percentages reveal that the ICT skills of most prospective teachers of NCOEs under the domain of Integrating are somewhat skilled (can perform independently but require guidance at times). Thus, the ICT skills of prospective teachers of selected NCoE were not at a satisfactory level. Therefore, to enhance the ICT skills of the prospective teachers a new learning methodology should be introduced.

Keywords: ICT, ICT literacy model, National colleges of education, Prospective teachers

RELATIONS OF JUNIOR SECONDARY STUDENTS' SATISFACTION OF BASIC PSYCHOLOGICAL NEEDS WITH THEIR ACHIEVEMENT IN PHYSICS

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Self Determination Theory (SDT) is a theory of motivation that supports academics and practitioners in understanding and enhancing student motivation and engagement that arises out of that motivation. While motivation arises from many different foundations (e.g., needs, cognitions, emotions, environmental events), the present study was viewed from a need-based perspective within the self-determination theory framework. According to SDT, three basic psychological needs must be satisfied for an individual to function optimally: Competence, Autonomy, and Relatedness (CAR). When these needs are supported, an individual can cultivate and achieve a greater sense of well-being. The aim of this study was to investigate the relations between junior secondary students' physics achievement with the satisfaction of Basic Psychological Needs (BPN). The explanatory-sequential approach was conducted in all five education zones in Jaffna District in the Northern Province, Sri Lanka. A convenience sample of 855 junior secondary students from 89 schools and three In-Service Advisors (ISA) participated in the study. The student-related quantitative data were collected using a standard BPN satisfaction questionnaire and an assessment test paper. In addition, qualitative data were collected in a focus group meeting from ISAs to explore their views on the current situation of physics teaching-learning processes according to the framework for understanding motivation in SDT. Quantitative data were analysed using SPSS 20.0. Qualitative data were analysed using thematic analysis. The results revealed that students' CAR was directly correlated to their achievement in physics and based on the result of the linear regression analysis, dependent variable achievement in physics can be predicted at the level of 4% ($r^2 = 0.04$) by the satisfaction of BPN. Also, ISAs' current view of classroom practice and teachers' understanding of building BPN among students were not at an adequate level. This study underlines that it is time for a paradigm shift from 'How can I motivate my students?' to 'How can I create the conditions within which my students will motivate themselves?'

Keywords: Basic psychological needs, Junior secondary class, Physics achievement, Self-Determination Theory (SDT), Student's satisfaction,

RELATIONS OF BASIC PSYCHOLOGICAL NEEDS OF JUNIOR SECONDARY TEACHERS WITH THEIR TEACHING PROCESS IN PHYSICS

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Physics education is a valuable tool for understanding the universe around us and sharing it with others. The students' performance in physics at examinations is not satisfactory in Sri Lanka. There are many factors affecting this poor performance including teacher causality, orientation, satisfaction, frustration, intrinsic and extrinsic goals, teaching efficacy, and motivation. Self-Determination Theory (SDT) can be used in classrooms to empower the teaching process. Thus, the purpose of this study was to investigate the relations of junior secondary school teachers' physics teaching process with the satisfaction of their Basic Psychological Needs (BPN) to find ways to enhance students' meaningful learning of physics. Data were collected from all five education zones in Jaffna District in the Northern Province, Sri Lanka. A convenience sample of 89 junior secondary science teachers and 3 In-service Advisors (ISA) participated in the study. Quantitative data related to teachers were collected using a standard BPN satisfaction questionnaire. Qualitative data were collected in focus group interviews with ISAs to explore their views on the current situation of the physics teaching-learning process according to the framework on motivation in SDT. Quantitative data were analysed using SPSS 20.0. Qualitative data were analysed using thematic analysis. The results revealed that teachers' basic psychological needs, such as relatedness, competence, and autonomy support, were directly correlated to their teaching-learning process. Linear regression analysis demonstrates that 30% of the effectiveness in the teaching-learning process can be explained by the satisfaction of BPN. According to the views of ISAs, the current classroom practices are not at a satisfactory level. Thus, this study suggests that using SDT in teaching among science teachers in junior secondary classes is useful in enhancing the effectiveness of the teaching-learning process of physics in schools.

Keywords: Basic psychological needs, Junior secondary classes Teaching learning process, Self-Determination Theory (SDT),

RELATIONS OF G.C.E. (ADVANCED LEVEL) STUDENTS' PHYSICS RESULTS WITH THEIR PHYSICS PERFORMANCE IN ASSESSMENTS, ATTENDANCE, STREAM, GENDER, AND G.C.E. (ORDINARY LEVEL) SCIENCE RESULTS: A CASE STUDY IN VAVUNIYA SOUTH EDUCATION ZONE

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Education is one of the major aspects of our life. Science education is the teaching, learning, and researching of science. It improves the quality of life through new technologies and methods. The Ministry of Education strongly advises all students to continue their studies at least until the General Certificate of Education (G.C.E. O/L) with science subject which is one of the core subjects. It also offers an avenue for students to choose science and technology streams in G.C.E (A/L). However, most of the students who are following these streams obtain poor results in their G.C.E. (A/L) examination. Moreover, students' performance in G.C.E. (A/L) physics is also at a lower level. Thus, this study investigates the relations of G.C.E (A/L) physics performance in students in Vavuniya South Education Zone with their physics performance in assessments, attendance, stream, gender, and G.C.E. (O/L) science results. The mixed-methods approach was used in this study with a convenience sampling technique selecting two schools in the zone. The sample consisted of 100 students who sat for their G.C.E. (A/L) examination in 2018 and 10 Physics teachers. Data were collected through Examination department results sheets, school database on term test marks, students' registration books, and interview schedules. Quantitative data were analysed using SPSS, while qualitative data were analysed through content analyses. The findings of the study showed that only 28% of the students' academic performance could be explained by their G.C.E. (O/L) science results. The findings revealed that there is no significant effect on G.C.E. (A/L) physics results across gender. Approximately, 27% and 70% of the students' academic performance depend on school attendance and the physics assessment marks in Grade 12, respectively. There is a significant difference in students' physics performance at G.C.E. (A/L) based on their stream. There is higher performance in biological science students than those in the physical science stream ($t(98) = 6.25, p = 0.01$). Qualitative findings indicate that it is important to pay attention to students' G.C.E. (A/L) attendance, their G.C.E. (A/L) physics assessments marks, science stream, and G.C.E. (O/L) science results in facilitating students' physics performance at G.C.E. (A/L) examination. Thus, the teaching and learning process of physics must be accomplished by considering different aspects to enhance G.C.E. (A/L) students' meaningful learning.

Keywords: Assessments, Attendance, Subject stream, Quantitative and qualitative analysis

THE EFFECT OF STUDENTS' MATHEMATICS SKILLS ON PHYSICS PERFORMANCE IN GRADE 11: A CASE STUDY IN A SCHOOL AT SRI JAYAWARDHANAPURA EDUCATION ZONE

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The study investigates the influence of mathematical skills such as computation, geometry, algebra, measurements, graphical analysis, and trigonometry in understanding physics concepts and potential measures to overcome the difficulties in grasping physics concepts. The sample consisted of 75 students and 10 teachers from Grade 11 at a 1AB school in Sri Jayawardhanapura Education Zone in Western Province. A convenience sampling technique was used to select the sample. The data collection instrument consists of two question papers (1 and 2), each on basic mathematical skills and physics concepts. Question papers were prepared based on the curricula of Grade 10 and 11. Students were trained on basic mathematical skills, and after the intervention, mathematics paper 2 and physics paper 2 were administered. Pearson product-moment correlation was obtained to determine the relationship between mathematics skills and students' performance in physics concepts. Results of the Pearson correlation indicated that there was a significant positive association between mathematical skills and the students' performance of physics concepts. Before the intervention, r and p values were $r(75) = 0.879$, $p < 0.001$, and after the intervention, they were $r(75) = 0.914$, $p < 0.001$, indicating that there was a statistically significant strong, positive correlation between mathematical skills and students' physics performance. As such, students' mathematical skills are to be enhanced to enhance students' performance in Grade 11 physics. The qualitative study was designed using semi-structured interviews with G.C.E. Ordinary Level science teachers. The qualitative data were subjected to thematic analysis. The three themes that were formulated include less interest in learning physics concepts, lack of competency in mathematical calculations, and lack of interest of teachers in physics practicals. It was further observed through discussions with the teachers that the weakness in subject knowledge of the school science teachers in physics affects students' meaningful learning. Hence, students' mathematics skills must be empowered appropriately to support students' physics performance at G.C.E. (O/L).

Keywords: Mathematics, Mathematical skills, Physics, Physics concepts

PARENTAL SUPPORT TOWARDS SCIENCE EDUCATION OF INDIGENOUS STUDENTS: A CASE STUDY IN THREE SCHOOLS IN UVA PROVINCE, SRI LANKA

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Parent support is one form of family involvement in science education. However, there is a paucity of studies on parental support for science education of indigenous students (Vedda students) in Sri Lanka. Hence, this study aimed to identify parental support of Veddas towards the science education of their children. The study was conducted in three selected schools with Vedda and mainstream students in the Uva Province, Sri Lanka, using an inductive, convergent mixed-methods approach. Quantitative data were collected from relevant items of two questionnaires given to parents (23 Vedda and 187 mainstream) and students (41 Vedda and 235 mainstream), respectively. Qualitative data were collected simultaneously through semi-structured interviews (14 Vedda parents, 17 mainstream parents, 10 Vedda students, 15 mainstream students, 7 science teachers, and 5 Vedda leaders/ senior community members) and 27 classroom observations (23 minutes average). Quantitative and qualitative data were analysed using descriptive statistics and thematic analysis, respectively. Most of the Vedda parents (47.8%) had studied up to Grade 5 and agriculture was the common income source of Vedda (78.3%) and mainstream parents (62.9%). Quantitative data showed many Vedda and mainstream parents encouraged children to learn science and are interested in science homework. Percentages of Vedda parents (56.5%) who were able to teach science and provide science tuition fees (4.3%) were less than those of mainstream parents (69.0% and 31.0%, correspondingly). However, responses of science teachers collected in the qualitative analysis showed that Vedda parents are not interested in the science education of their children in contrast to mainstream parents. Further, qualitative data showed that mainstream parents were more capable of providing additional science learning opportunities and teaching science at home compared to Vedda's parents. Hence, it could be concluded that the ability of Vedda parents to support science education through teaching at home and providing additional learning opportunities is relatively less compared to mainstream parents. Comparatively poor education level, unawareness of the formal education system, and poor economic strength could be the reasons for the above situation. Hence, improving awareness of Vedda parents on science education and providing science education effectively at schools is important to enhance the science education of Vedda students.

Keywords: Mainstream, Parental support, Science education, Vedda

A REVIEW ON ABSENTEEISM OF STUDENTS IN G.C.E. ADVANCED LEVEL CLASSES IN SRI LANKA

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The General Certificate of Education (G.C.E.) Advanced Level (A/L) Examination is one of the most important examinations in the Sri Lankan Education System as there is great competition to gain entry to government universities. Thus, the government provides the physical and human resources necessary to support the learners. However, student performance is not as good as expected at the examinations. There may be many factors that contribute to this situation. One of the factors could be student absenteeism in G.C.E. (A/L) classes. Hence, this study aimed to identify the major reasons for absenteeism in G.C.E. (A/L) classes in schools. Moreover, the study further investigated the reasons for student preference for private tuition classes over school education. The convenience sampling technique was used and qualitative data were collected using a student questionnaire. Data were analysed using thematic analysis. Approximately 20 students and eight teachers from four provinces in Sri Lanka participated in 10-minute interviews. Approximately 90% of the G.C.E. (A/L) students believe that the mode of knowledge delivered by private institutions is more helpful compared to schools. However, the results revealed that there is not much difference in teaching strategies between schools and private tuition classes. Furthermore, students are of the view that they are unable to get through the competitive G.C.E (A/L) examination without attending tuition classes. Though, schools provide reasonable facilities such as laboratories, libraries, computer laboratories, and human resources, the students' absenteeism in schools at G.C.E. (A/L) classes has created a serious issue in the Sri Lankan education system. Thus, the prevailing situation should be remedied through a suitable motivation mechanism to increase students' regular attendance in schools to meet national goals of education through optimal use of national resources.

Keywords: Absenteeism, G.C.E. (A/L), Student performance

**EFFECTIVENESS OF APPLYING SELF-DETERMINATION THEORY IN
LEARNING CHEMISTRY: A CASE STUDY IN TANGALLE EDUCATION ZONE**

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This study was designed to examine students' psychological well-being, motivation, and performance in the Grade 12 Chemistry classroom. Self-Determination Theory (SDT) is appropriate to apply in an educational context to enhance students' motivation for learning. This theory is a psychological framework that addresses three psychological needs, competence, autonomy, and relatedness. The objectives of the study were to implement SDT using a multi-approach teaching-learning process to promote students' enjoyment in the Chemistry classroom and to examine student performance and motivation after the intervention. The research sample consisted of hundred students enrolled in Grade 12 science classrooms in two 1 AB schools from the Tangalle Education Zone selected through the convenience sampling technique. A quantitative research approach was used in the study. A pre-test was conducted to make sure that there is no statistically significant difference in students' performance between the experimental and control groups before the intervention. The Control group was taught using the traditional method while the experimental group was instructed using the SDT approach. Lessons conducted in the study included: properties and reactions of acids and bases; balancing redox reactions; chemical calculations; chemistry of Na and Mg; and d-block complexes and colours. Two Likert scale questionnaires were used to collect data from two groups. A motivation questionnaire was used to measure students' motivation for learning chemistry, whereas, a learning climate questionnaire was used to measure students' competence, autonomy, and relatedness during the learning process. Both questionnaires were administered before and after the teaching-learning process. Post-test was conducted to check student performance in both groups at the end of the intervention. Data were analysed using SPSS. Results indicate that motivation in the experimental group has increased significantly compared to the control group ($t(98) = 5.766, p < 0.001$). Moreover, the experimental group (mean = 79%) demonstrates slightly higher performance compared to the control group (mean = 75%). Thus, it can be concluded that students' motivation and performance are directly affected by the teaching approach. As such, the findings suggest using appropriate classroom practices to enhance students' meaningful learning in Grade 12 Chemistry.

Keywords: Motivation, Performance, Self-Determination Theory

TEACHER AND STUDENT PERCEPTIONS ON MOTIVATION AND ACHIEVEMENT ON GRADE 12 CHEMISTRY: A CASE STUDY IN TANGALLE EDUCATION ZONE

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Motivation of students in learning is an important factor to enhance their academic performance. Students who are not motivated do not learn effectively. This study focused on student and teacher perceptions of student motivation and their achievement in G.C.E. (A/L) Chemistry. The research sample consisted of hundred students in Grade 12 science stream from two 1 AB schools and eight teachers from the Tangalle Education Zone. The experimental group students were instructed to address three basic psychological needs based on the Self-Determination Theory (SDT), such as competence, autonomy, and relatedness while practicing the traditional approach for the control group. Qualitative research method was used in the study. Qualitative data were collected from the semi-structured interviews and analysed using thematic analysis technique. The results revealed that students' motivation is highly affecting their achievements in Chemistry learning. Teachers' autonomy support and peer learning also enhance student motivation and achievement. Teacher perceptions emphasize the effects of teaching approach on students' motivation, and performance; available school facilities, overburden curriculum and insufficient time allocation on student meaningful learning; motivation, positive attitudes, and aspiration towards Chemistry learning. Student fear on learning chemistry, low level of cognitive and psychomotor skills, and poor self-concepts towards chemistry lead poor academic achievement. Moreover, student perceptions indicated positive relations of novel approach on students' interest and enjoyment; teacher support towards student motivation; and development of student soft skills through peer learning. Thus, the findings of this study suggest using effective teaching methods, appropriate teaching styles in the lessons, enhancement of motivation of students and teachers toward the teaching and learning process to facilitate meaningful Chemistry learning at G.C.E. (A/L) in the Sri Lankan context.

Keywords: Achievement, G.C.E (A/L), Motivation, Self-Determination Theory

EFFECT OF TEACHER QUALITY AND STUDENT PERFORMANCE OF ICT

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Teaching Information and Communication Technology (ICT) in Sri Lankan schools started in 2007 as an optional subject for Grades 10 and 11. Later, ICT was introduced to the General Certificate of Education (G.C.E.) (A/L) as a subject for all streams. Due to the importance of ICT, the government has included it in the curricula of Grades 6 to 9 allowing learning opportunities for every student. Yet, a recent analysis of the G.C.E.(O/L) ICT results in the Central Province of Sri Lanka, shows a decrease in pass rates over time. This observation resulted in this quantitative study to explore the causes of the decline and suggest viable solutions to increase student performance in ICT. Based on the literature survey, teachers have been identified as a prominent factor that affects student performance. Further studies revealed that the quality of the teacher is one of the most critical components for improving students' achievement and reducing achievement gaps among students. Thus, the link between teacher quality and student performance was selected to be explored in the study. The quality of a teacher was evaluated using factors based on previous research. The study sample consisted of 76 randomly selected ICT teachers from government schools. An online questionnaire was used as the data collection tool. Based on the responses recorded in the questionnaire, differences in teacher preparedness, teaching methodology, and communication skills were identified using weighted means and standard deviation. In teaching methods, the weighted mean was approximately 3.5. Though all teachers had basic qualifications in ICT, the standard deviation was over 9. Higher standard deviations imply a high degree of variation among teaching methodologies and communication skills among teachers. The student performance in ICT would be enhanced by providing opportunities to enhance communication skills and teaching methodologies among ICT teachers.

Keywords: ICT, Student performance, Teacher quality

INTRODUCTION OF A DIGITAL PLATFORM TO ASSESS STUDENT ACHIEVEMENT LEVELS IN SCIENCE

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It is well known that teachers' understanding of student achievement levels is essential to enhance their performance in education. Even though student achievement level is assessed at present in Sri Lanka, it takes a long time to communicate that information to the teacher and other relevant authorities. Therefore, this study aims to introduce a digital platform that is assessable to students, teachers, education administrators, and any relevant person who can log in to the system. This provides timely information which helps teachers to get the required decision during the teaching-learning process. The system was piloted with Grade 11 students in the central province in 2020. According to the thematic analysis of views of teachers, parents, and students, the system allows teachers to organize their teaching-learning process according to the student achievement level and to provide immediate feedback. Moreover, the system encourages students to engage more in studies to achieve their target level. Since the students have immediate feedback from the system their self-learning mode is stimulated. Furthermore, the system consists of a question bank in which students can perform an unlimited number of tests. Since it is paperless work, the tests are environmentally friendly and sustainable. As the system is online there is no need to administer tests at the same time or in school. Hence, students can work at flexible times. In addition, the data provided by the system show that continuous awareness and a regular monitoring process are vital to reaching the goal of the project.

Keywords: Achievement level, Feedback, Question bank, Self-learning, Teaching-learning process, Unlimited tests

SUCCESS OF THE NEWLY INTRODUCED TECHNOLOGY STREAM IN G.C.E. (A/L): A CASE STUDY IN THE WESTERN PROVINCE OF SRI LANKA

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A society with a high level of proficiency in technology is a key factor in the development of a country. Thus, technology education plays an important role in the school curriculum in both developed and developing countries. The technology stream has been implemented in the Sri Lankan education system since 2013 to improve the technological proficiency of society. In addition to resolving the inequalities in the selection of subject streams at the General Certificate of Education (Advanced Level) or G.C.E. (A/L), the Ministry of Education also aim at increasing the student numbers in the Science stream from 22% to 40% and in the Commerce stream from 27% to 35% while discouraging students entering the Arts stream from 51% to 25%. This study was conducted to investigate whether these objectives of the newly introduced Technology stream were achieved or not. To fulfil the aim of this research, documentary evidence was collected. The number of qualified students for the G.C.E. (A/L) examination, the number of students who sat for the G.C.E. (A/L) examination, and the number of students qualified for the universities from 2008 to 2020 in the Western Province were collected from the documents received from the Department of Examinations in Sri Lanka. The data were analysed for descriptive statistics. The results showed that after introducing the Technology stream, the percentage of the number of Science and Commerce students increased from 2019 to 2020 and from 2016 to 2019, respectively and these percentages continue to increase. Thus, it is revealed that the expected level of increase in the Science stream seemed to be achieved but the expected levels of Commerce and Arts streams have not been achieved yet. The passing rate of Commerce, Arts, and Science streams were higher compared to the Technology stream. However, the passing rate seems to be increasing in the Technology stream over time. Finally, this study showed that most of the objectives of the introduction of the Technology stream have been achieved. Both students and parents should be made aware of this opportunity to reach all the aims of introducing this new technology stream into the Sri Lankan education system.

Keywords: G.C.E. (A/L), Objectives, Technology stream

**IMPACT OF TEACHER PERFORMANCES ON STUDENTS' SCIENCE
LEARNING: A CASE STUDY IN BADULLA EDUCATION ZONE**

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The teacher plays a vital role in the teaching-learning process. The teacher also imparts knowledge through various teaching approaches, methods, and aids, using which students sharpen their skills, knowledge, and attitudes. Teachers, therefore, play an important role in the lives of students. On the other hand, the knowledge of science spreads all over the universe and it is important for the students for various activities. Therefore, it is important to explore the impact of teacher performance on students' science learning. To achieve this goal, a study was conducted using the General Certificate of Education (G.C.E.) Ordinary Level (O/L) students from 21 selected schools in the Badulla Education Zone, Sri Lanka. Data were collected using two separate questionnaires, interviews, and observations. These questionnaires were given to 2 samples of 300 students and 25 teachers who are teaching those classes. Qualitative data were analysed by thematic analysis and quantitative data were analysed using Minitab and Microsoft Excel. Information on teachers' performances was collected under the following parameters namely punctuality, management skills, friendliness and patience, subject knowledge, and communication skills. Punctuality ($r = 0.734$), management skills ($r = 0.691$), teacher subject knowledge ($r = 0.682$) and communication skills ($r = 0.756$) were strong and positively correlated with students' science scores. However, teacher friendliness and patience were weakly positively correlated with student science scores ($r = 0.281$). Similar results were obtained through qualitative analysis as well. This study revealed that educational goals can be achieved by improving children's science learning by increasing the productivity of teacher performances. The findings of this study can be used to guide children's education on an effective and successful path.

Keywords: Correlation, Parameters, Students' science learning, Teacher performances

**IMPACT OF STUDENTS' PERSONALITY TRAITS ON THEIR SCIENCE
LEARNING: A CASE STUDY IN BADULLA EDUCATION ZONE, SRI LANKA**

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Learners are unique in their respective actions, thus they are interested in a variety of learning styles. The demographic background and personality traits of the students influence their learning process. Moreover, knowledge of science takes the lead in solving tasks and problems of everyday life. Thus, it is important to look at the impact of student behaviour on their science education. Hence, the General Certificate of Education (G.C.E.) Ordinary Level (O/L) students from 21 selected schools in the Badulla Education Zone of Sri Lanka were selected in this study. Further, data were collected from questionnaires, interviews, and through observations. Separate questionnaires were administered to 300 students and 25 teachers who teach in those classes. Quantitative data were analysed using Minitab and MS-Excel and qualitative data were analysed through thematic analysis. Information such as parental support, health, active participation, interest in the subject, and interest in practicals was collected. According to the results, a positive correlation was observed between student' achievement in science with health, parental support, interest in the subject, and active participation separately ($p < 0.05$), demonstrating the Pearson correlation coefficients, (r) = 0.149, 0.172, 0.220, and 0.342, respectively, confirming that the correlations are positive. However, no correlation was observed between students' interest in science and practicals ($p > 0.05$). The study revealed that no matter what teaching style teachers used, students' academic performance may vary depending on their personal traits. As such, if the situation of a student changes appropriately, the student' performance in science can be enhanced.

Keywords: Active participation, Correlation, Health, Parental support, Personality traits

MULTI-APPROACH METHOD IN G.C.E. (A/L) BIOLOGY TEACHING: A CASE STUDY FROM NUWARA ELIYA, SRI LANKA

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In Sri Lanka, G.C.E. (A/L) examination is a critical turning point in student life as it is based on meritocracy, deciding the future careers of students. Thus, students are expected to obtain high grades in this competitive examination. However, in 2018 marks obtained for Biology by Grade 12 students in a selected school in Nuwara Eliya were not satisfactory. It was revealed that all students attend private tuition classes, thus, they learn lessons in the tuition class before learning them in school. This could be one of the reasons for low levels of motivation among students to learn the same lesson twice using the same lecture-based method. Hence, it was decided to implement a multi-approach teaching method through group work, exhibitions, library books, and academic counselling to improve student motivation in learning. Accordingly, these different teaching methods were introduced to Biology for Grade 12 students in 2019. Mixed methods approach was used in this study to facilitate data triangulation. Convenience and purposive sampling techniques were used in the sampling process. Groups 1 and 2 included all Biology stream students (n = 13) of Grades 12 and 13 in 2018. Group 3 included all Biology students of Grade 12 in 2019. Grade 12 students in 2018 were taught using the conventional lecture method. Grade 13 students in 2018 were taught using a multi-approach method consisting of question-answer sessions, group work, exhibitions, and library books. Students in the Group 3 were taught through question-answer sessions and group work. Practical and academic counselling was conducted on all groups. Biology marks scored in the term test by all groups were recorded and analysed. Results revealed that the highest score was obtained by Group 3. Moreover, Group 2 has obtained higher scores than Group 1. Thus, it can be concluded that methods used in teaching Groups 2 and 3 are more effective in enhancing students' motivation and performance compared to the conventional method used in Group 1. Hence, the multi- approach method could be used in Biology teaching at G.C.E. (A/L) to facilitate students toward meaningful learning.

Keywords: Biology, G.C.E. (A/L), Motivation, Multi-approach method, Performance

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