

ARRIVING AT BETTER POLICY RECOMMENDATIONS

**Applied Research with
Agency Partnership**

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Arriving at Better Policy Recommendations

Applied Research with Agency Partnership

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Foreword

This publication originates from the “Applied Research with Agency Partnership” initiative of SLIDA which aims at encouraging public sector managers to undertake research on issues in public administration and management, highlighting recommendations for improving performance.

The publication constitutes two separate research studies. The first examines why “Vidatha” technical training has been less effective in producing skilful entrepreneurs, and the second looks at why mathematics results of students in the Polonnaruwa District continue to be at a low level.

Today’s changing face in Sri Lanka’s economic development emphasizes on a public-private partnership. In this respect the need for mechanisms to foster both the cognitive and technological performance capacities of small and medium scale entrepreneurships (SMEs) are essential for a bottom up contribution to the country’s economic development. Within this context, ground level entrepreneurship development agencies such as “Vidatha” Centers are of much relevance and importance. Hence, the study and findings on “Challenges to Create Successful Rural Entrepreneurship through Technical Transfer Training,” will provide an opening for decision makers to revisit the roles, responsibilities and performance capacities of such institutions in the provision of directions for the productive performance.

In perusing the second research study we all have to agree that Mathematics is indeed one of the most important subjects which facilitates further study especially in the fields of Science and Technology. The findings from this study reveals that there is a continuing high percentage of failures in Mathematics in all districts including Polonnaruwa. The study focuses on the need for better and more student friendly teaching methods and a conducive learning environment for Mathematics teaching and learning.

Thus, highlighting the need of a paradigm shift in the overall teaching and learning environment of Mathematics not only in the Polonnaruwa district but in all other districts, as well.

It is envisaged that the findings of these two studies would act as stimulants for policy makers to initiate more in-depth research and formulate relevant policies for implementation to the betterment of the country.

Wasantha Perera

Director General

Preface

“Applied Research with Agency Partnership” is a prominent initiative for development of research skills of public sector policy makers in Sri Lanka, and for encouraging research findings to be used for better policy making. This initiative has been aided by European Union Support to the District Development Programme (EU-SDDP), and implemented by the United Nations Development Project (UNDP) - The Governance of Local Economic Development (GLED) Project.

As the Editor and the Academic Coordinator of this work, I am delighted to present the two studies which have been successfully completed. Study One examines the use of effective technical transfer of training at “Vidatha” Centres and how some key processes have been ineffective in achieving successful results. The study examines certain key elements such as selection criteria of trainees, training design, training demands, training and marketplace opportunities, government support, policy directives, and utilization of small-scale entrepreneurs in local businesses.

Study Two analyzes how the national school curricular is related to Mathematics, and the teaching, learning methods conventionally concentrated impact on low mathematics achievements. The two studies bring a number of conclusive findings, and reveal the importance of systematic examination of some prolonged issues in the public sector if we are to understand them better.

The Applied Research initiative aims not only at developing research skills of practitioners, but emphasizes the importance of in-depth, careful analysis of everyday issues before proposing policy directives. This programme, initiated in year 2014 under the leadership of Mr. J. Dadallage, former Secretary, has been continued under the leadership of Mr. J.J. Rathnasiri, present Secretary Ministry of Public Administration and Management.

Mrs. Mala Basnayake, Additional Secretary and Mrs. Wasantha Perera, DG/SLIDA have contributed their support to finalize the two studies and to proceed to publication. The two researchers, Ms.M.A.Renuka Sudharshani and Mr. H.M. Upatissa Kumaratunga have completed their studies with great enthusiasm. Ms. ChandimaWalpitagama has contributed immensely with administrative assistance.

I convey my thanks to all who have contributed to this initiative, and very importantly recall the continued encouragement, and the financial support, received from the UNDP and EU Projects Team.

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STUDY 1

A Study on Challenges to Create Successful Rural Entrepreneurs through Technical Transfer Training

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ABSTRACT

The research focuses on how Technical Transfer Training at Vidatha Centres has not been able to produce successful entrepreneurs in rural areas. The objective of the research is to recommend mechanisms towards developing entrepreneurship among rural communities through Technical Transfer Training via Vidatha Centres. The instruments for acquiring primary data in the research are questionnaires, interviews, observations, and meetings. The methodology adopted with questionnaires is to administer them to a sample of sixty participants, one each from ten selected programmes comprising sixty trainees. The ten programmes are decided on through cluster sampling methods. Secondary data is excerpted from reports, CDs, modules, and handouts from various relevant institutes, and books and articles cited in the Literature Review.

The existing circumstances at Vidatha Centres is assessed under three criteria, viz. selection of participants for training, changing the formats of training in the technological programmes for rural communities, and integration of training related services and relevant sectors, internally and externally. Vidatha would be expected to nurture Small Scale Entrepreneurs by providing opportunities for them to generate income through the coordination of the efforts of other institutions, and by cooperating with other institutions. If the present recommendations are accepted, entrepreneurs will be encouraged to continue their enterprises with the help of Technical Transfer Training provided by the Vidatha Centres.

CHAPTER 01

Vidatha Technical Transfer Training

1.1 Challenges of Small and Medium Entrepreneurship

Entrepreneurship is essentially related to income generation efforts and an entrepreneur can be defined as a person who sets up, and manages their own business of producing goods or services for the market. Those living in rural areas engage in informal employment such as self-employment, running individual or family business units, as a family, or individually, mostly through part-time efforts. This does not support the uplifting of their living standards, and conditions as their efforts are mostly unviable. The underlying causes could be insufficient knowledge, meagre enthusiasm, interest, and endeavour. Hence, they engage in several jobs at the same time or in part-time work for wages.

In Small Business (SB), the entrepreneur has to play the Manager's role taking various decisions related to marketing, finance, production, Human Resources Management, etc. The following problem areas are identified as major factors contributing to the slow growth rate of this sector in rural areas.

- Negligence and lack of experience in time
- Lack of experience in finance and management.
- Lack of resources such as land, funding, technology, etc.
- Lack of knowledge on entrepreneurship awareness on business development services.
- Lack of skills on computer literacy, especially the use of the Internet.

While these may be highlighted as the reasons for the failures in the local SB sector, it would be apposite to recognise that owners of SBs totally depend on welfare programmes such as food stamps and Samurdhi. Some of these programmes support the income generation efforts of the SB entrepreneurs. Hence, they wish to protect their welfare benefits and prefer to aver that they are not totally dependent on their own fulltime enterprises, because of the

probability of losing welfare benefits. A self-employed person is not wholly a genuine entrepreneur. Further, they need to evolve through the growth stages of micro, small, medium entrepreneur, and achieve the status of a large-scale entrepreneur. The stages of progression to a successful entrepreneur demand improvement through successive steps. Modern advanced technologies in Small & Medium Business (SMB) introduce a considerable number of innovative products, and generate more employment in the job market.

It is believed that, in a developing country such as Sri Lanka, a positive correlation exists between entrepreneurship development, especially in the private sector, and the degree of economic achievement through their income generation efforts. Consequently, almost all the developing countries have, through their national development plans, formulated entrepreneurship development programmes, business development services, funding methodologies and marketing strategies for the Small and Medium Entrepreneur (SME) sector.

In the Narammala division, a number of small entrepreneurs have been trained annually, but only a few of them have continued in their SBs full time. Therefore, their income levels cannot appreciate. It has been observed that some of those trained abandon their projects without facing market competition, and in the face of failure to produce marketable goods. Analysis of the number trained in 2013, and 2014, indicates that only a few persevere in the self-employment field after training. The situation in nearly all the programmes is similar.

The objective in introducing “Vidatha” is the transfer of science-based technology to provide scientific and technical training to rural communities in order to develop the competency necessary to create small and medium scale entrepreneurs. In evaluating the realisation of goals by Vidatha, it is necessary to identify why the success ratio is comparatively not high. This has been the stimulus to engender this research.

Various institutions such as the Small Business Development Ministry, Industrial Development Board (IDB), Samurdhi and Poverty Alleviation Ministry, and recently the Vidatha (විද්‍යාදාන කාක්ෂණය) Centres under

the Ministry of Science and Technology, have channeled funds to produce entrepreneurs at rural level. This is in spite of technical shortcomings in the products marketed by the self-employed, and by the efforts of rural individuals not in full time employment.

Vidatha Centres, which are special technical units, have been established in each Divisional Secretariat area. Up to now, 261 Centres have been established towards increasing job opportunities among villagers, as they have been, so far, deprived of opportunities to expand income generation, and to empower them. In a national development initiative, it is difficult to minimise poverty without utilising the potential capacity of rural resources.

Vidatha is an agency of the Ministry of Science and Technology and is supervised by the Divisional Secretary at divisional level, and managed by a Vidatha officer at the centre.

Prior to the establishment of the Vidatha Small Enterprises Development Division (SEDD), the Kurunegala District Secretariat operated as one of the agencies in the sphere; the Industrial Development Board (IDB) is the institute addressing the situation. These entrepreneur development agencies, including Vidatha, have suggested the following areas to be improved in this context.

- Identifying and selecting potential entrepreneurs with due care.
- Identifying, selecting, and validating entrepreneurial opportunities.
- Creating awareness on latest technologies in promising sectors.
- Providing information on potential technologies, projects, products, and services.
- Developing entrepreneurial and motivational competencies.
- Linking entrepreneurs with viable projects where credit facilities are available.
- Equipping entrepreneurs with enterprise development/formulating skills.
- Equipping entrepreneurs with managerial and problem solving skills.

- Assisting entrepreneurs in networking to secure necessary finance, infrastructure, and other ancillary support.
- Following up, monitoring, and evaluating the entrepreneurs who have started business under special training programmes.

If Vidatha Technical Transfer Training is productive, the income generation levels would be satisfactory. However, at first glance, it is evident that Vidatha beneficiaries are struggling to dispose of their products in a competitive market as a whole. Finally, the research identifies suggestions and recommendations to overcome the problem.

The problem is presented within these parameters.

1.2 Statement of the Problem

The Vidatha training programme has been ineffective in producing successful rural entrepreneurs through Technical Transfer Training.

1.3 Significance of the Problem

The following require analysis and address.

- Selecting participants to become successful entrepreneurs through Technical Transfer Training.
- The scope of technical training linked to participants' requirements and rural self-employment.
- Positioning of integrated services supportive of technical training.

1.4 Overall Objective and Specific Objectives

Overall objective

- Examine the ineffective capabilities of Vidatha and improve entrepreneurship in rural communities through Technical Transfer Training.

Specific Objectives

- Enhance scope and methodology in, and design of, demand driven programmes.
- Propose, expand, and integrate training supportive services.
- Create awareness in productive connectivity between training and income generation.

1.5 Methodology

Primary Data in the research is collected through an opinion survey questionnaire administered to a sample of 60 participants out of the 10 selected training programmes conducted from 2013 to 2015. One participant is selected from every 10 selected programmes of 60 trainees. The ten training programmes are identified by cluster sampling methods and a sample of 60 participants is selected through simple sampling methods, to choose participants who could advance the research. Ten trainees are selected for interviews. Further, observations of human and physical resources, meetings with Vidatha members and relevant officers, and case studies of beneficiaries are also employed.

Analysis Methodology: Data and information provided is analysed using the following indicators.

- Selection criteria of the participants focusing on demand driven and market supportive training.
- Integration of training related services and relevant sectors.
- Changes in the nature of training in the technological programmes for the rural communities.

Secondary Data is extracted from external reports, CDs, programmes, modules, handouts, and budget reports, action plans of the relevant institutes, books, and articles.

1.6 Scope and Limitation

Vidatha activities in Narammala are chosen as being representative of an area. Curriculum modules, training prospectuses, nor standard training modules devised by the Ministry of Science and Technology, or any other agency, are available for comparative assessment.

CHAPTER 02

Use of Entrepreneurship at Vidatha Centres

2.1 Views on Entrepreneurship

Technical training provided by Vidatha Centres consistently strives to enhance entrepreneurship skills through raising the threshold of technological knowledge. Then, trainees can venture into the world of entrepreneurship as successful businessmen by employing innovative efforts in order to gain market advantage. In this context, Austrian economist Joseph Schumpeter's theory of entrepreneurship is applicable to practices at Vidatha Centres. The following theories need to be considered in efforts to transform the self-employed, or small businessmen into genuine entrepreneurs through Vidatha Technical Training. The word, 'entrepreneur' originates from the French word, *entrepreneur*, which means, 'to undertake'. In a business situation, it means to start a business. The Merriam-Webster Dictionary defines an entrepreneur as, 'one who recognizes, manages, and assumes the risks of a business, or an enterprise'.

A number of definitions of "Entrepreneurship" can be found. Schumpeter's definition of entrepreneurship places emphasis on innovations, for example, a) new products, b) new production methods, c) new markets, d) new forms of organisation.

Wealth is created when innovations result in increased demand. From this viewpoint, one can define the function of the entrepreneur as one of combining various input factors in an innovative manner to add value for the customer with the hope that this value will exceed the cost of the input factors, thus generating superior returns that result in the creation of wealth.

2.1.1 Entrepreneurship vs. Small Business

Many use the terms 'entrepreneur' and 'Small Business Owner' synonymously. While the words may have much in common, significant differences between an entrepreneurial venture and a small business, define the words. Entrepreneurial ventures are different from small businesses; they are different from each other qualitatively and quantitatively.

- Quantity of wealth created: rather than merely generating an income stream that replaces traditional employment, a successful entrepreneurial venture creates substantial wealth, typically in excess of several million dollars of profit.
- Speed of wealth creation: while a successful small business can generate several million dollars of profit over a lifetime, entrepreneurial wealth creation is, often, rapid, for example, within 5 years.
- Risk: the risk of an entrepreneurial venture needs to be high. Otherwise, with the incentive of assured profits, many entrepreneurs would be pursuing the idea, and the opportunity would not exist any longer.
- Innovation: entrepreneurship often involves substantial innovation beyond what a small business might employ. This innovation gives the venture the competitive edge that results in wealth creation. According to Peter F. Drucker (2001), the innovation may be in the product or the service itself, or in the business processes used to deliver it.

Howard Stevenson (1999), the godfather of entrepreneurship studies at Harvard Business School, defined that entrepreneurship, 'is the pursuit of opportunity beyond resources controlled'. Considering these definitions, it is possible to recognize that an entrepreneur should take risks and overcome uncertainty gradually, and that entrepreneurship is an engine of global economic growth, a force for positive change in society. To accomplish these, the entrepreneur should have interest, enthusiasm, and endurance, and be trained to update knowledge, skills, and attitudes. Vidatha is one of the institutes that delivers the above training requirements in entrepreneur development.

2.2 Vidatha (Vidya Dāna Thākshanaya)

“Vidatha” was launched to transfer scientific knowledge and technical innovations to rural communities towards producing small and medium entrepreneurs.

The following have been introduced by Vidatha Centres.

- Training in technology for entrepreneurs, future generations, the community.
- Identifying division wise the technology competency and the resources in rural areas.
- Conducting technology transfer programmes in order to develop self-employment.
- Motivating rural communities to use IT and technical equipment.
- Supplying quality assured goods to the market to enhance village incomes and stabilizing incomes.
- Stimulating rural communities to obtain quality certification (GMP) such as SLS and ISO at concessional rates.
- Establishing a database for human resources and rural resources.
- Establishing Vidatha Societies to facilitate loans and information, and to organise teams among members of communities.
- Facilitating bank loans for Vidatha beneficiaries.
- Introducing modern technology to advance knowledge, skills and attitudes of rural manufacturers through the local centres, and through other government and nongovernmental organisations which contribute.
- Improving traditional technologies in applicable manner.
- Showcasing new technological equipment and machinery produced at research institutions.
- Assisting in the acquisition of universal knowledge in science and technology.

Vidatha is an organ of the Ministry of Science and Technology which formulates policies, plans and regulations, and the budget for Vidatha, and directs and facilitates operations. Further, the Ministry promotes the flow of input from technological and scientific institutions such as Arthur C. Clark Centres, Sri Lanka Standards Institute, National Engineering Research and Development Centres (NERD), and Industrial Technological Institute.

At the Vidatha Centres, delivering technology comprises three strands as following,

- Primary technology free of charge.
- Secondary technology at concessionary rates.
- Higher technology at reasonable rates.

Members of rural communities, mostly, come to Vidatha Centres to acquire Primary technology free of charge. However, these participants need to improve their income generation capacity, especially through Secondary and Higher technology.

Basic Training Programmes delivered at Vidatha cover the following areas.

Introducing simple cheap technology for households, e.g.

- Rice Cooker using coconut charcoal as fuel.
- White coconut oil extractor.
- Wood fired oven.
- Vegetable cutting machine.

They mostly target users directly, and do not contribute much to enhance income generation. Although small entrepreneurs acquire this training, it does not directly help to increase their income, but is used in self-employment, mostly for consumption, instead of generating income.

Technology training for small, medium enterprises.

- Food technology for dehydrated fruit and vegetable.
- Bakery products.
- Ornamental candle production.
- Dairy products.
- Rice based products.
- Cement building blocks, concrete door and window frames.
- Jam, cordial, chutney.
- Radio & TV repair and antenna design.
- Mobile phone repair.
- Leather bags and shoes.

Through these programmes, Vidatha expects to enhance the technical competency of SMEs to create entrepreneurs, not merely self-employed persons. Incremental stages of progress in the self-employed are,

Self-employer → Entrepreneur, (Micro, Small, Medium, Large)

2.3 Small Enterprise Development Division (SEDD)

Small Enterprise Development Division established by the Ministry of Youth Affairs has a considerable history and experience in entrepreneurship development than Vidatha. Although Vidatha aims at promoting entrepreneurship improvement through Technical Transfer Training, it has to focus, as adequately as it is able, on overall training demands of beneficiaries, because technical improvement is only one facet of entrepreneurship development.

The Vision of the SB Division is, “Entrepreneurship and Enterprises Development for sustainable growth”. The Mission is, “To provide maximum contribution for national development in Sri Lanka”.

The roles of this agency can be identified as,

- Motivating unemployed youth to access fields of enterprise.
- Enhancing entrepreneurial capabilities in youth.
- Improving efficiency and productivity of enterprises.
- Coordinating operations of relevant institutions to obtain technical training, knowledge of productivity, quality standards, price control, labelling, packaging, etc. and facilitating loans and promoting enhanced market growth, e.g. Producing project reports for SMEs, displaying and providing knowledge from other institutions, coordinating with banks to provide loans to SMEs.
- Providing services to support development of enterprises, e.g. Organising annual exhibitions, participating at annual exhibitions at BMICH.
- Nurturing a 'Local Entrepreneurial Culture' through the development of entrepreneurial capabilities in youth below 45 years.
- Generating job opportunities and uplifting living standards of youth through identification of new enterprise opportunities and guiding the youth to start enterprises.
- Generating more job opportunities and increasing income levels in youth through improving the efficiency and productivity of youth enterprises.
- Contributing actively to ensure the effectiveness and consistency of Micro and Small Enterprises.

SEDD pays special attention to initial training and workshops for entrepreneurs for the purpose of changing attitudes, identifying interests and realisation of aspirations within the target group, more than Vidatha. As an example, at their 21 whole day training workshop in one Small Business training programme, observation tests with games and interviews, and exercises, are utilised to assess the suitability of the participants to receive the 21-day training which includes demonstrations, and field visits to medium level entrepreneurs' factories.

2.4 Industrial Development Board (IDB)

The Industrial Development Board is another agency established under Act No.36 of 1969 vested with the responsibility of developing industries in Sri Lanka, promoting industrial growth and encouraging entrepreneur development to create a market-oriented economy in Sri Lanka. The agency guides the Small Business community at the three levels of helper, coordinator, and mediator. The mission of the agency is to provide and facilitate demand driven quality services to make Sri Lanka's enterprises globally competitive through an island-wide network of dedicated and innovative teams to achieve business excellence.

Nature and Scope of IDB

Within the scope of the stated mission, Entrepreneurship Development Programmes of IDB,

- Identify and select entrepreneurs. Development officers at divisional level perform this task.
- Deliver Preliminary training in three stages for which fees are payable as half of total amount initially, or the whole amount.
 - Generate ideas for your business - GYB
 - Starting your business - STB
 - Improve your business – IYB

Examples of indoor training are programmes in Business Planning & Management, Financial Management, Reporting Accounts, Marketing, Purchasing of handbooks and manuals. Capacity building for productivity and quality development through workshops,

- In situ Technical training at production sites.
- Demonstrations on process technology and Technology Transfer Programmes.
- Staff Training in attitude changing and development.

Vidatha selects as limited target groups those that have enthusiasm for small business and possess some degree of literacy, because of the fees charged for training. IDB also try to streamline and complete their training with demonstrations with the help of advanced, medium level entrepreneurs and commercial entities, exhibitors, machinery manufacturers, etc.

Marketing Services

IDB and the Small Business Division have demonstrated that they have more capacity than Vidatha to provide information to SMEs to coordinate market potential at the training stage and in showcasing, infrastructure facilities, (Food, Chemicals, Oils & Fibre, Minerals & Construction material), organise the Industrialists association, services at industrial planning stage, information on industrial technology.

Special consultancy services, quality assurance, and the 5S programmes for productivity improvement are provided by the IDB. It is involved in technical oriented training demanded by markets, infrastructure services, and provides an information network more extensive than Vidatha. Sometimes, SEDD gets assistance from the IDB to transfer technology to rural communities.

CHAPTER 03

Case Investigation: The Methodology

This chapter discusses the methods used for data collection and data analysis in the main field of data collection.

3.1 Primary Data Collected through Questionnaires

A questionnaire on an opinion survey is administered to a sample of 60 participants selected from 10 identified training programmes of 2013 to 2015. One is selected from every 10 selected programmes containing 60 trainees. A questionnaire is appropriate in this context to elicit specific information which contributes to the evaluation of Vidatha Centres. The ten training programmes are identified through cluster sampling methods, and a sample of 60 participants is selected by simple sampling methods. Through this mechanism, participants who would drive the research could be distinguished.

The ten cluster programmes are,

- TV, and Radio repair,
- LED bulbs
- Readymade garments
- Incense sticks
- Leather bags and shoes
- Dehydrated food
- Yoghurt and other dairy based products
- Jam, Cordial and chutney
- Mobile phone repair
- Mushrooms

In these circumstances, random sampling is not expedient because not every trainee possesses the same capacity to contribute viable ideas.

Interviews

Ten trainees from each of the 10 selected programmes consisting of 60 trainees in each are picked. The Head of the Ministry of Science and Technology, the Director of the Vidatha section of the Ministry, and the Vidatha officer at the Narammala Centre are also interviewed. The Heads of institutes with similar aims and objectives as Vidatha, for example, the SED, and the IDB are also interviewed. The information from these sessions is cited in the Literature Review. The Vidatha officer at Narammala Centre is interviewed on three occasions. The officer explains their action plan of training courses, the resources, limitations, achievements, failures, and obstacles.

Observations

Physical and human resources of Vidatha, and locations where enterprises are operated are observed. Advantages and limitations of Vidatha could be observed through this approach.

Case studies

Apart from the above method, three instances of success and failure are studied.

Meetings

Three meetings were held with 'Vidatha Sansada', which brings together entrepreneurs.

Analysis

Data and information obtained through these methods is analysed with the following specified indicators. Only quantitative data collected through surveys is analysed in a whole chi-square test and some simple mathematical quantitative tests. Data is discussed and interpreted with qualitative data collected by other methods including interview, observation, and related case incidence. The nature of the research topic demanded more qualitative data to achieve research objectives; these include interviews, observation related case incidence, and questionnaires as well. As an example, most of the data

has been collected through questions on points of view, attitudes, ideas, and about training experience in Small Business.

3.2 Selection of Participants for Training

Different methods may be employed to select participants who possess enthusiasm, courage, receptivity, and positive backgrounds. An appraisal whether the methodology adopted complies with the situation, and whether the techniques require modification for improved efficiency, is done.

3.3 Integration of Training Related Services and Relevant Sectors

Certain variables are considered in assessment.

- Funding (Loan and recovery systems, machinery, and equipment).
- Delivery of services and Market support.
- Opportunities for use of Advanced Technology.
- Patent Licensing and Business registration, GMP.
- Synergy among relevant sectors, internally and externally.

The operations that should be integrated, viz. human resources, women 'vanitha' poverty alleviation, internal welfare delivery, market & delivery services, vocational training, and contributions from other institutes promoting entrepreneur development externally are identified.

The following training areas have been assessed

- Skills: Vocational skills, Technical skills, Management skills, Communication skills, Entrepreneurship skills.
- Knowledge: Account Reporting, Knowledge in developing business ideas, Planning, Loss and Benefits, Revenue and Expenditure, Market driven business, Customer care, IT.
- Attitude: Pursuit of comparative advantage, motivation

Secondary Data is culled from reports, CDs, modules, handouts, budget reports, action plans of relevant institutions, external resources of books and articles. These are cited in the Literature Review. Some of these help to compare figures such as expenditure for training.

CHAPTER 04

The Role and the Participation During Training at Vidatha

4.1 Pertaining Issues

Vidatha's main objective in transferring technology to rural communities is first assessed through a mathematical table and a chi-square test of data collected through surveys and reports to elicit the successes of Vidatha functions. Next, the result is discussed with the reasons identified through interviews, observations, meetings, and questionnaires, within stipulated criteria.

The disparity between the number of trainees and those remaining in the field is 461. In the final analysis, actual expenditure by the government per Vidatha employee is 611.25. It is higher than the expenditure per participant which is 130.38. The difference between the two categories is 480.84. If each trainee engages in a small business, government expenditure for each person per programme reduces: the programme could become cost effective. The information shows that although some individuals participate in several programmes, on different occasions, the least number from these have already launched their own self-employment projects.

According to the test, the critical value is greater than the actual value. The analysis rejects the alternative hypothesis and accepts the null hypothesis. This indicates that transferring technology through the expenditure of the identified cost per participant by Vidatha does not produce desirable outcomes.

4.2 Participation of Self-Employed in Vidatha Programmes

A higher percentage of participants are females, and among them, the highest number is in the production of garments. The second choice among females is dehydrated food technology. Both products face market competition. According to the results of interviews with participants, dairy product technology is a viable sector.

Within two years, a large number of participants were attracted to new programmes, for example, to LED bulb production and to Mobile phone repair. Observation and interviews divulge that incense sticks, garments, and leather bag production face increased market problems.

The absence of specific strategies to win a market share in the face of competition among heterogeneous (similar) products could be the cause. Finishing, packing, quality assurance and fluctuations in the target market that demand attention are not dealt with through the use of their theoretical knowledge.

4.3 Income of Vidatha Participants

Based on the information provided by surveys, income levels of Vidatha beneficiaries can be categorised as follows.

No considerable change of income as a result of Vidatha training manifests itself according to the results. The growth in the ranges, 5,001-10,000, 10,001-15,000, and 15,001-20,000 is small. Large and Medium level entrepreneurs, for example, from 10,001 to 25,000, employ labour. The beneficiaries of training have recruited marginally more employees. This becomes evident at observations and interviews.

Most of the participants are 41-50 years, and 31- 40. As stated earlier, participation of females is comparatively higher. Participation of males is slightly higher only in the 31- 40 range. The number of Vidatha beneficiaries qualified at OLs is higher, although their educational backgrounds are different, as a whole, their literacy rate is favorable. The Vidatha permanent staff of three includes the Vidatha officer who holds a Bachelor of Science degree. Although the staff is insufficient, it may not be appropriate to increase administration costs at Vidatha through further recruitment. The participants have not been able to earn and make their life successful in keeping with their academic achievements. However, most of them are knowledgeable, and capable of receiving training easily.

4.4 Selection of Participants for Training

Participants are mostly inducted through information provided by GNs and field officers. In rural communities, on limited occasions, individuals who are familiar with Vidatha training request training, especially regarding the demands in food technologies. Courses are commenced once an adequate number of participants is enrolled.

Any individual can join Vidatha programmes. They are not assessed for suitability, and capabilities to receive training in certain programmes, and are admitted sans interview. Some who do not have the commitment, interest, and readiness in the chosen business, join training programmes, but find it difficult to continue in business.

Some individuals rotate to a number of training programmes without continuing one business, because there is no mechanism to create preliminary awareness before formal training begins, and to identify genuine training needs, and to change attitudes. An essential limited group that will benefit through technological training cannot be identified through this technique.

4.5 Integration of Training Related to Services and Relevant Funding

Funding

Loan requirements and recovery systems, and requirements of machinery and equipment are discussed here. Narammala centres do not possess any records of facilitating funding, or loans with Vidatha intervention, but banks are requested to facilitate loans at concessional rates. Self-employed are mostly Samurdhi beneficiaries, therefore, they comply with their loan requirements through Samurdhi banks, and to some extent personally, through other banks.

At a centre, only a limited number of demonstrations can be conducted, as equipment such as dehydrating ovens, yoghurt incubators, baking ovens, etc. available at the centres are minimal depending on the resources at each centre.

A structured programme to provide machinery and equipment free of charge, or at reasonable rates, to Vidatha beneficiaries by prioritising their

self-employment requirements, has not been formulated. Beneficiaries trained at Narammala Vidatha centres have been provided machinery and equipment under other programmes launched by Samurdhi, the Small Enterprises Development Unit, and the Ministry of Economic Development in 2014. Sometimes, the self-employed who receive basic training at Vidatha are able to secure assistance from other institutions such as the Samurdhi Ministry, when these institutions conduct such programmes.

Marketing and Delivery

Marketing and delivery are not extensive as Vidatha participants have limited markets. Achieving a desirable market share for the same type of goods is difficult. Beneficiaries do not appear to possess the knowledge necessary to make differentiation in products, or to follow strategies to attract customers as they cannot identify present and future markets.

Most of the trainees start similar industries, and the competition for market shares escalates. Therefore, benefits through marketing are insufficient even for survival.

Opportunities for Advanced Technology

SME entrepreneurs who desire advanced technological training are provided the opportunities with the mediation of the Ministry, channeling them to institutions such as the Arthur C. Clark Institute, NERD, Industrial Technology Institute, Sri Lanka Standards Institute, and the Post Harvesting Institute at Anuradhapura.

It would appear that other advanced training opportunities, and enthusiastic Vidatha beneficiaries who can choose their dedicated technological field are not identified. This hinders the creation of successful entrepreneurs through Vidatha training. Therefore, most beneficiaries continue as self-employed with low income.

Patent Licensing and Business Registration

Vidatha trainees are not familiar with GMP which is the patent license for those in Small Businesses. Therefore, they do not consider obtaining it. However, GMP could be recognised as another standard certificate like SLS. At interviews, trainees divulged that they do not like to follow the procedure to obtain GMP, because of the difficulties in complying with the requirements. The trainees do not possess sufficient knowledge to comply with the requirements of GMP or SLS.

Connectivity between Internal and External Sectors

Sectors such as Human Resources (HR), Vocational Training (Nipunatha), Samurdhi, and poverty alleviation (DiviNeguma) and Vanitha, all which cater to entrepreneur development, operate in divisional secretariats, but these sectors function separately, therefore, sufficient results do not seem to come about due to the lack of interconnectivity and synergy between the sectors in the divisional secretariat.

Apart from that, Vocational Training and other institutes including SED, IDB stand externally in entrepreneur development. Coordination in their similar activities by sharing experience, problem solving, and maximising profit, and benefits is lacking. As a whole, Vidatha beneficiaries are not recognised: in some situations, they have not even been considered suitable for selection to acquire the wherewithal for self-employment, e.g. machinery and equipment, by field officers of other line Ministries. (In the course of the research, it was remedied to some extent in order to connect the most suitable people from all low-income SB holders.)

4.6 Changing Approaches in Training of Rural Communities

A shortcoming in Vidatha training is highlighted as the results of observation and visits: the training has not focused on market demand, and does not succeed in product delivery. Vidatha mostly provides technical skills, basic business knowledge, and account reporting to some extent. Programmes on customer care, market driven business, entrepreneur management, loss and profit balance, and IT programmes are rarely made available. Equipment in Vidatha centres is also not adequate. Therefore, certain issues occur in the

field. This is evident through observation of some business locations, and reviewing case studies.

Case Studies

The Case Studies are based on interviews, observations, and visits. Food Technology (at Ranawatta), Footwear production (at Peragasella).

- **Successes:** An entrepreneur at Ranawatta manufactures jam, chutney, achcharu (pickles), and cordial under the label, 'Neeranga', and faced market competition successfully with product differentiation, and comparative price adjustments, winning several awards, while providing jobs for six. The training which underpins the success was received at the Agriculture Department at Gannoruwa, the Agromart Foundation, SED, and finally at Vidatha. The government aided the project with machinery appraising the determination and courage of the entrepreneur, who now has four employees, and serves as a Resource Person at Vidatha when necessary. Vidatha has influenced the entrepreneur to an extent in the progress.
- **Failure:** This entrepreneur at Peragasella was trained to produce footwear (shoes) and handbags. The capacity in the enterprise to deliver the required quantities on time, and the designs produced were limited to meet the market demand. Therefore, it was not possible to face competition while breaking even. In a situation such as this, advanced technology, knowledge in quality improvement, and financial investment are imperative to meet demand.

Common Issues

- The labour of individuals in rural communities is not fully utilised, and rural resources and potential energy are underutilised. Self-employment appears to be the limit of achievement of individuals in rural communities; proceeding beyond does not seem to be possible.
- Some technical weaknesses are present in rural products made by the self-employed.

- Individuals in rural communities find it too big a challenge to survive in the face of market competition.
- Low profit generation compared to manufacturing cost.

Training methods, Design, Content of Technological Training in Vidatha programmes are not adequate practically to some extent, and cause SB entrepreneurs to become only part-time self employed, having failed to meet supply and demand, and customer expectation.

CHAPTER 05

Recommendations and the Way Forward

To achieve their objective, the Ministry of Science and Technology has defined the policy framework and the regulations for Vidatha to a certain extent. Therefore, within a short period, Vidatha has become an agency that is very close to the rural communities in the division. However, in the final analysis, it is clear that a void exists between government efforts, and the results in real terms when all the facts are studied. The results do not indicate so strongly the expeditious achievement of goals.

5.1 Results

As a whole, the level of performance in transferring technology to rural communities is currently at a low pitch. When compared with other similar institutions in general, Vidatha is actively functioning at a moderate level.

Government Expenditure

One of the findings of this research, however, is the opportunity to compare government expenditure on Vidatha. Actual outcomes of Vidatha are not satisfactory, because only 21.33% of the original roll of trainees continue as employed.

Integration

A person with a Bachelor of Science degree of a Technological Institute is in charge of a Vidatha centre. Operations at the centres continue satisfactorily. Two others of the staff work without additional remuneration contributing as resource persons when necessary.

Advanced Technological Training

Advanced technological training is insufficient and not organised with promptitude. Until the present, only a limited number of institutions has been identified. The Ministry spends on different types of Vidatha training, free of charge, at different levels of participants. It is an additional burden.

Financial Support

Adequate financial support, and simplified loan facilities to beneficiaries towards developing their enterprises is not provided. A systematic plan to donate machinery and equipment to beneficiaries is not implemented.

Marketing and Delivery

The scope of marketing and delivery is not extensive. SMEs who received training from other institutes attempt to produce similar (heterogeneous) goods for the market. This results in the loss of market benefit, or the ability to survive. Some products such as food items, and garments, enter a competitive market. No collective effort has been made to organise SME entrepreneurs in the division to advance their market share exploiting their capabilities and resources.

Patent Licenses and Business Registration

Entrepreneurs are not enthusiastic about obtaining patent licenses and business registration, because they have limited knowledge of this, and GMP is not widely recognised.

Scope of Training

Data from observations and from interviews suggests that knowledge and skill in small entrepreneurs is deficient because the training is not adequate and not systematic in order to support the creation of successful entrepreneurs through Technical Transfer Training, and the absence of systematic format and effective methods to train and to evaluate training.

Income Levels

Data suggests that most Vidatha beneficiaries have small incomes, because so far, they have only been self-employed.

Participation of Females

Female participants enhance the living standards of the family, therefore, youth should be encouraged to establish the foundation of the technological frameworks for small businesses.

Education Level

Education levels of trainees are adequate to receive technical training; it is possible to design technical training at any level.

Selection Methods

Essential analysis of SME training needs, systematic methods for selection, and mechanisms for creating basic awareness to identify final parameters for formal training are not in place.

Divisional officers such as the Vidatha officer, development officers, officers on women's affairs, human resource assistants, social service officers, and Samurdhi Managers carry out welfare and development activities, from identifying requirements of low income rural communities, to providing assistance, to raise their thresholds without an integrated approach towards the family.

5.2 Recommendations

Recommendations essential as constructive measures to create successful entrepreneurs through technical transfer training are reviewed.

Method of Selection

Streamline selection procedure to retain persons with enthusiasm, preparation, and favourable backgrounds to engage in the field of SB.

Organise Vidatha centres to carry out, with the support of officers operating mobile services at rural level, to identify individuals who could justify their selection and their prioritised training needs, through discussions. The Grama Niladari, the Economic Development Officer, and relevant divisional level field officers need to function as a team to identify candidates for training, using simple interviews, games, and appropriate demonstrations.

Internal Integration

Form a Committee of officers at District Secretariat level to discuss training needs, required training programmes, suitable participants, and their physical resources. The Committee comprises officers, who are presently tasked with the responsibility of improving the economic status of the self-employed or the entrepreneurs in small industries. On Wednesday, when the Vidatha officer, too, reports at the Divisional Secretariat, the Committee meets; the Divisional Secretary, or the Assistant Divisional Secretary takes final decisions. This approach contributes towards selecting the most suitable families to be provided with Technical Transfer Training.

Advanced Technological Training

Commence, urgently, training in advanced technology. For this, the Ministry coordinates with higher technical educational-vocational institutes, more than as done at present. This contributes towards providing even job opportunities for beneficiaries.

Financing

To organise small, mutual support groups of Vidatha Society members is important. The National Savings Bank, or the Regional Development Bank, or any other bank with similar commitment is requested to inaugurate loan cycle programmes. The Ministry of Science and Technology launches a structured programme to introduce such a loan programme with the participation of suitable state banks where loan recovery operations are simplified quickly. To encourage these, only initial funding is paid to these banks to start the loan cycle.

Provide machinery and equipment at three stages, assessing the requirements of the self-employed, and their levels of income.

- Free of charge
- 50% of equipment expenditure
- Concessional rates

Marketing and Delivery

Train identified participants for each and every course of training. They are guided and facilitated to choose one or several business fields which have maximum market benefit and production expenditure. Product differentiation, price, and market are expected to attract various target groups.

Patent License and Business Registration (GMP)

Establish separate programmes for beneficiaries to prepare GMP, including training in quality control, purchasing, finishing, and packaging, etc. GMP ought to be used only to certify the stages of improvement in SB. The Ministry develops a scheme for linking the SB entrepreneurs to acquire ISO after they are made aware of the recognition they bestow.

Entrepreneur Training

Reorganise entrepreneurship training in three stages, as practised at IDB. Initially, improve entrepreneur skills, marketing skills, and SB management skills.

- Starting a business
- Generating ideas for your business
- Improving your business
- Deliver training in the first stage, to make beneficiaries aware of SB, to develop attitudes and motivation using games and demonstrations.
- Deliver sufficient training, congruent with the nature of technological training, in the second stage; the training is designed to eliminate knowledge deficiency and to improve the skills in marketing and enterprise management skills. Redesign content, format, and methods of training to answer to the requirements of target groups. The approach consists of demonstrations, games, case study, and field visits. These are productive, for, example, 21 days of initial training for newcomers delivered by SED.

- Administer a questionnaire, after training, to monitor training and results, to appraise whether changes would improve training. Stimulate SME entrepreneurs to develop productive business plans through analysis of the business according to results of individual SWOT tests. (Strengths, Weaknesses, Opportunities, and Threats).
- Train Stage 3 beneficiaries until they reach the maximum level of technical competency within Vidatha capacity, using qualified resource persons. Train the self-employed to use IT for accounting. Provide opportunities for the use of computers at Vidatha Centres.
- Prepare, with the assistance of professionals, structured modules for courses which are already conducted as decided by the Ministry.
- Levy a training fee from Stage 3 trainees, who earn at a medium level, to provide advanced training. This could reimburse the service expenditure. IDB provides fee-levying services to the clients. What Vidatha charges from rural communities to minimize government expenditure is on a reasonable basis.

External Connectivity

Formulate policy at the Ministry of Science and Technology to coordinate institutions established for SMEs with the interaction of relevant line Ministries at national level. As human resource involvement can favourably affect small industries and related institutions, IDB, SEDD, and Samurdhi Department, etc. work together as support institutions to achieve common goals. e.g. a) Help in developing a complete project proposal to obtain bank loan facilities: the self-employed work with SEDD.

- Call up all SB entrepreneurs, whether they belong to any regional vocational institute or not, to conduct special technical courses.
- Stage exhibitions in each GS division periodically, and facilitate them by providing stalls, electricity, etc. at reasonable rates. In this way, SME entrepreneurs share each other's capabilities. (e.g. resources, semi finished products, etc.)

District Level Units

Establish district level units to strengthen, coordinate, control, and promote Vidatha, vis a vis other institutions. All Vidatha Centres are covered at district level and an officer of the Sri Lanka Administrative Service functions as the authorised officer.

Integrate support services such as providing information, guidance, financial support, marketing coordination, and help with quality control, and providing showrooms for small business under one roof as far as feasible. A Vidatha district unit is developed as an incubator to assure stability to those employed at Small Business level.

These recommendations enhance the capabilities of entrepreneurs in rural communities to continue their enterprises with the help of effective Technical Transfer Training given by Vidatha centres to achieve the overall objectives.

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STUDY 2

**Analysis of Factors Cansing Low Results
Mathamatics in Polonnaruwa Educationl
Zone Schools**

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ABSTRACT

This action research identifies the reasons to produce a low pass rate in the study of Mathematics in provincial schools of the Polonnaruwa Education Zone, Polonnaruwa District in Sri Lanka. The study has critically investigated students' expectations and teaching, delivery methods as core contributory factors for Mathematics performance in the Ordinary Level Examinations (O/Ls).

A deductive approach is used to acquire data. A simple random sampling technique is used to select the elementary units of the sampling frame which incorporates the empirical evidence obtained from the students. A structured questionnaire focusing on the dimensions of service quality such as teaching methodology, classroom atmosphere, etc. contributing to satisfaction in students is administered to the 100 selected students in the zone. The Lickert mean is used as the score line, and standard deviation is used to check the level of significance of each factor influencing the low results. A conceptual model, and a hypothesis are formulated to prove the relationship between service quality dimensions and student satisfaction. Research findings reveal that service quality dimensions influence student satisfaction in the schools.

The study has revealed how learner environment including teaching delivery methods and the motivation of students to learn Mathematics become key factors to receive a satisfactory outcome in performance. In fact, the significant contribution from the teacher for better teaching and relationship management have become valid actions.

CHAPTER 01

School Level Mathematics Learning

1.1 Importance of Mathematics as a Distinguished Subject

The research examines the dynamics that lead to low achievements in Mathematics at provincial schools, with special reference to Polonnaruwa District. The proficiency in Languages, Science, and Mathematics is seen as an essential prerequisite to success in school education. Mathematics is the tool and the language of Commerce, Engineering, and other sciences, such as Physics, Computing, Biology, etc. Mathematics as a component of formal education was developed about 5,000 years ago by the Sumerians. This was accomplished simultaneously by them along with the development of reading and writing.

Over the past three decades, several definitions for Mathematics have been offered.

Aristotle's *The Science of Quantity*. In Aristotle's classification of the Sciences, discrete quantities are studied using arithmetic, and continuous quantities through geometry. The 'indirectness' in Comte's definition of the Science of Indirect Measurement (Comte, 1851) refers to determining quantities such as the distance to planets, or the size of atoms, that cannot be measured directly, by means of their relations to quantities that can be measured directly. Mathematics is the science that draws necessary conclusions (Peirce, 1870). Peirce did not think that Mathematics is the same as logic; he thought that Mathematics makes only hypothetical assertions, not categorical ones. All Mathematics is Symbolic Logic (Russell, 1903). On the other hand, Russell's definition expresses theological philosophy of Mathematics without reservation. According to the above definitions, Mathematics has a relationship between problem solving, and decision making.

The study poses a question on awareness of low levels of achievements in Mathematics in schools.

1.2 Research Problem

Achievements in Mathematics in provincial schools in the Polonnaruwa district are low according to reports from Educational Offices, newspaper articles, news in electronic media, and discussions at meetings.

Mathematics results at the Ordinary Level Examination (O/Ls) and general results overall are evident with the following:

- Cause a decline in enrollment at A/Ls.
- Increase the number of school leavers after O/Ls.
- Impact on the school image.
- Impact on problem solving and decision making skills of the students.
- Generate a large volume of social criticism.
- Affect employment negatively.

1.3 Research Questions

To what extent are/is

- The Education Zone Office, Provincial Department and Provincial Ministry capable of identifying viable policy making processes to meet justifiable student expectations?
- All Educational Officers capable of identifying appropriate programmes to cater to student expectations?
- Mathematics teachers capable of identifying correct teaching processes to promote student achievement?
- All Educational Officers capable of identifying appropriate teaching methodology beneficial to the students?
- Classroom atmosphere responsible for low achievements at O/L Mathematics.

1.4 Objectives

- Offer solutions to the Provincial Education Department for the low levels of achievements in Mathematics at O/Ls in schools of the Polonnaruwa Educational Zone in the Polonnaruwa district.
- Study/examine the dynamics causing low achievements at O/L Mathematics in the Polonnaruwa Educational Zone in Polonnaruwa district.
- Identify/recognise the impact of teaching methods in connection with low achievements in Mathematics in the Polonnaruwa Educational Zone in Polonnaruwa district.
- Identify/recognise the impact of classroom atmosphere in schools on low achievements in Mathematics in Polonnaruwa Educational Zone in Polonnaruwa district.
- Offer conclusions and recommendations based on the empirical survey chosen as a scientific approach.

1.5 Methods

The research identifies/recognizes, and analyses teaching methodology, and approaches in connection with low achievements in Mathematics, identifies/recognizes, and analyses classroom atmosphere in schools impacting on low achievements in Mathematics.

Participant-observation is conducted by the researcher for approximately five hours per day, over a sixteen-week period, from 1 October to 31 December 2015. Typically, observations are made at morning meetings with each teacher. A survey among 100 unsuccessful students of Mathematics in the 10 provincial schools is also conducted. Each student answers a survey consisting of ten questions that assesses their experience of teaching methods, and classroom atmosphere related to Mathematics. The survey takes about 20 minutes at each school.

CHAPTER 02

Mathematics and Students' Performance

2.1 Mathematics and Educational Achievements

Different definitions of mathematics achievements are stated in this section. The researchers study mathematics achievement from several angles. Low achievements are related to early-school leaving, socio-economic disadvantage, and migrant status. Achievements are realised through effort and hard work. Achievement is the preferred word in the educational, or psychometrics fields, being sometimes characterized by the degree of inference required on the part of the student to give a response, and by the type of reference to a cognitive process made explicit in the measurement tool. However, mathematics researchers propose the following definitions.

Educationally, achievement is the mastering of major concepts and principles, important facts, and propositions, skills, strategic knowledge, and integration of knowledge (Niemi, 2002). More systematically, achievement is sometimes fractionated into knowledge components like declarative, procedural, and strategic (Shavelson & Ruiz-Primo, 1998). It is also known that achievement in mathematics is based on the type of courses a student takes, not the type of school attended.

The most relevant theories, under different sub headings of mathematics achievements, are stated. The researchers measure performance in mathematics in different ways. Measuring achievements in mathematics is an important issue to most educational establishments. Today's school reform initiatives often centre on using student performance to gauge school, teacher, and effectiveness. This accountability is important in certain ways. Mathematics achievements are assessed in different ways. It is observed that the dynamics identified below affect mathematics achievements in the school.

2.1.1 Assessment

Assessment strategies are aligned with standards/concepts that are taught to evaluate both student progress/performance, and teacher effectiveness.

- Utilizing student self-monitoring techniques.
- Providing guided practice with feedback.
- Conducting error analysis of student work.
- Assessment strategies can be classified as diagnostic, formative, or summative.

2.1.2 Diagnostic Assessment

Diagnostic Assessment strategies focus on assessing students' prior knowledge, strengths, weaknesses, and skill levels. This particular approach improves the learning experience and the level of achievement. However, Diagnostic Assessment looks backwards, rather than forwards. The process assesses what the learner already knows and/or the nature of difficulties that the learner might encounter, which, if undiagnosed, might restrict their engagement in new learning. It is often used before teaching, or when a problem arises.

2.1.3 Formative Assessment

Formative Assessment provides immediate feedback, and evidence of student performance. On the other hand, formative Assessment is utilised in the short term, as learners are in the process of making meaning of new content, and integrating it into what they already know. Formative Assessment is as informal as observing the learners' work, or as formal as a written test. Formative Assessment is the most productive type of assessment for improving student understanding, and performance.

2.1.4 Summative Assessment

Summative Assessments are more comprehensive, and are typically administered at the end of a specific unit, or timeframe. (Computing Technology for Math Excellence, 2006). Summative Assessment tends to have the least impact on improving an individual student's understanding,

or performance. Students/parents can use the results of Summative Assessments to see where the student's performance lies, compared either to a standard, or to a peer group of students. Teachers/schools use this method to identify strengths and weaknesses of curriculum, and instruction, to produce improvements among the following year's/term's students.

2.2 Factors Associated with Mathematics Learning

Many relevant theories of mathematics achievement are identified. The researchers study mathematics achievement from the viewpoints of different theories about mathematics. Proficiency in Languages, Science, and Mathematics is seen as an essential precursor to success in modern society. Attitudes and influences on their development in relation to differences among students are identified as three groups of factors that play a vital role in influencing student attitudes (Mohamed & Waheed, 2011).

- Factors associated with the students themselves (e.g. mathematical achievement, anxiety, self-efficacy, and concept of self, motivation, and experiences at school).
- Factors associated with the teachers and teaching (e.g. teaching material, classroom management, teacher knowledge, attitudes towards Mathematics, guidance, beliefs).
- The home environment and society (e.g. educational background, parental expectations).

Class environment, where students perceive teachers as supportive, promote student feelings of control and confidence in their ability to succeed. The manner in which students view the teachers' characteristics affect the students' attitudes towards mathematics. A significant relationship exists between the learning environment, and attitude towards mathematics. Students with a higher perception of the learning environment, and a more positive perception of their teachers have more productive attitudes towards mathematics. Students display more positive attitudes toward mathematics when their teacher is perceived as highly supportive.

Many researchers have employed several tools in assessing Mathematics achievements:

- Teaching Methods
- Classroom Atmosphere

2. 2.1 Teaching Methods

Empirical evidence suggests that the correlation between teaching methods and student achievements is very high. Mathematics teachers have a nuanced task. The teachers must motivate students, and try to teach them to persevere when problems challenge. The quality of teaching, and learning in mathematics is a major challenge for educators. The current debate among scholars is what students should learn to be successful in mathematics. The discussion emphasises new instructional design techniques to produce individuals who can understand and apply fundamental mathematical concepts. A central and persisting issue is how to provide instructional environments, conditions, methods, and solutions that enable students with different skills, and ability levels to realise learning goals. Innovative instructional approaches and techniques need to be developed to ensure that students become successful learners.

It is important for educators to adopt instructional design techniques to attain higher achievement rates in mathematics. (Rasmussen & Marrongelle, 2006). Where students' needs and their comprehension of higher-order mathematical knowledge are considered, instructional design provides a systematic process, and a framework for analytically planning, developing, and adapting mathematics instruction. Saritas explains (2004): "Instructional design is an effective way to resolve many pressing problems in education. Instructional design is a linking science, a body of knowledge that prescribes instructional actions to optimise desired instructional outcomes such as achievement and effect." (Reigeluth, 1983, 5). Instructional design alone cannot produce better learning and achievement. The instructional designer must recognize crucial factors that affect student learning, and build a bridge between goals and student performance. Identifying these factors will help to utilise limited resources including financial resources, and time, more effectively.

There are some vital teaching methodology indicators as the following:

- Use of visuals
- Connectivity
- Assessment
- Strategies
- Number of Maths facts at a time
- Cumulative Practice
- Verbalised thinking
- Feedback
- Presentation and Explanation
- Group work

2. 2. 2 Classroom Atmosphere

A student sits in a school classroom for a long period of time and learns the various skills deemed necessary to achieve success in the global society. In the classroom, the students gain an understanding of their place in the world, and the gifts they have to offer it and a perception of what they want their future to look like, as well as knowledge of the skills needed to reach that goal. With the classroom being such an important place in the growth of a student, it is imperative to understand the ways in which to improve methods that incorporate maximum effectiveness in instruction. Positive classroom environments are associated with a range of significant outcomes for students. Many studies regarding student achievements in mathematics, and the environmental effects on their self-efficacy are available.

Factors such as class size, class climate, and limitations in teaching, and their relation to Mathematics achievement have also been extensively studied. (Howie, 2005). Classroom atmosphere is defined as ‘the classroom environment, the social climate, the emotional, and the physical aspect of the classroom.’ (Ibid). A great deal of research done in this sphere in the last 25 years supports the importance of the Mathematics climate on student self-efficacy in the subject.

Fresko and Ben-Chaim focus on 5 different aspects of the classroom-learning environment (difficulty, speed, satisfaction, diversity, and inquiry) across 80 Junior High Mathematics classes in Israel (Fresko & Ben-Chaim, 1989). Many studies survey student achievements in Mathematics and the environmental effects towards establishing a classroom environment that promotes interaction, and improved student behaviour.

Classroom Atmosphere indicators are,

- Wall charts
- Arrangement of furniture
- Resources
- Colour
- Air circulation and ventilation
- Temperature
- Class size

2.3 Indicators to Measure Mathematics Performance

The indicators and measures are shown again as subheadings focusing research questions and research objectives.

These indicators affect low achievements in Mathematics.

- Teaching methods
- Teaching methods indicators
 - Visuals
 - Connectivity
 - Assessment
 - Strategies
 - Number of Maths facts at a time
 - Cumulative practice
 - Verbalised thinking
 - Specific feedback

- Presentation and explanation: communication skills
- Group work

Visuals

Visual teaching is a teaching/learning approach in which, ideas, concepts, data, and other information are associated with images, graphics and techniques. Those who learn through this approach are often referred to as visual-spatial learners.

The visual approach processes information better when it is in the form of,

- Pictures
- Images
- Graphics
- Charts
- Computer presentations
- Colour-coded Maths problems.

Connectivity

Making connections is at the heart of teaching/learning Mathematics. Murray (2001) has introduced the following to connect with students.

- Making it meaningful
- Starting with concrete examples – leaving abstract concepts to a later time
- Starting with an interesting real-world problem, preferably localised
- Creativity and ownership
- Engaging your Maths students
- Asking more interesting questions
- Stimulating students to pose their own questions
- Project work

Assessment

Teachers need to be aware of their students' problems while the students learn: their progress, and the level of formality they are operating at so that the teachers adapt the teaching strategies to meet the students' needs. This information is elicited in a variety of ways that range from observations and discussions to multi-step tasks and projects, from self-assessment and homework to oral presentations. (Black & William, 1998).

Strategies

Mathematics involves problem solving using strategies. Sometimes, there is only one way to solve a problem, but often there are multiple avenues to the answer. When teaching, several strategies for understanding, and exploring a concept are modelled. Although mathematics usually only has one right answer, being able to reason through the steps to find the answer is the most important part of being a successful student of mathematics. Students are encouraged to apply higher order skills when given problems, and to focus on the thought process involved in the solution.

Number of Mathematic Facts at a Time

Figuring out an answer, and memorising facts are different. If students have too many facts to learn at one time, they necessarily fall back on figuring out the answer. Instead, we want students to remember the answers without having to figure them out.

Cumulative Practice

Practice is the manner in which developing student practitioners engage increasingly with the subject matter as they grow in maturity and expertise.

Verbalised Thinking

The process of students verbalizing, step-by-step, how they got to an answer helps other students to learn basic procedures. Most teachers are aware that many students hesitate to raise their hands in class to ask questions for fear

of sounding unintelligent. When a student explains how they got to the answer, they are helping their classmates. Explaining the processes may also help them to learn how to solve problems. This helps them to recognise the strategies they are using, and to develop the potential to apply the strategies to other areas of learning.

Specific Feedback

According to the Institute of Education Sciences, when teachers give specific feedback to the students on what they do correctly, and where and how they can improve, many students benefit. Teachers ought to present their students with opportunities to correct their answers and see the errors they have made. Such feedback helps students to be guided to find the answers by themselves, instead of teachers simply giving the correct answer and telling them where they went wrong.

Communication skills, Presentations and Explanations

Human attention is limited. Too much information, whether in slides, or in speech, is not remembered. The art of communication involves listening, and speaking, as well as reading and writing. Proficient communicators receive information, comprehend and synthesise it, and express themselves at a high level. Such individuals make excellent teachers, because they are able to transmit knowledge, skills, and values, while demonstrating that they care for the students entrusted to them. The teachers help motivate students to learn. Effective communication includes transforming the boring into the interesting, and having good presentation skills. Teachers need to be highly skilled in all these aspects of language to excel in their profession.

Group Work

The aim of group work, for both the teacher and the students, is to work together to gather and enhance knowledge. Solving problems in groups involves each person in the group contributing and listening to others. Even if their ideas may not be 'correct', group members still reflect on these ideas together. Everyone in the group understands the work being done and comes together to agree on the problem through productive discussion while working on it (Barash & Webel, 2013). Following aspects are considered when planning group work.

A. Classroom Atmosphere Indicators

- Arrangement of classroom furniture
- Resources
- Colour
- Air circulation and ventilation
- Temperature
- Class size

B. Use of Wall Charts

In a classroom, what is valued is displayed on the walls. In today's classrooms, space is often at a premium. Teachers struggle to get it all in: the students, the desks, the tables, the books, the manipulatives, etc. The space crunch applies to classroom walls: between the whiteboard/blackboard, the shelves, and the windows. What is displayed on the walls is identified selectively. Students pick up on this quickly. They identify that a chart, a graphic, etc. is displayed on the walls, because it means something to the teacher, and hopefully, to the students. In addition, that it is a reflection of what is valued most. When pre-made, store-bought bulletin boards, posters, decorations are displayed, the message is that they are valued. When the walls hold students' work in art, writing, etc., the teachers show the students that the creativity of the students is valued. If a wall shows an anchor chart, we value students' thought. When our walls hold Maths based graphics, the focus is Maths. To create the environment where students embrace Mathematics learning, and vocabulary, it is necessary to show that Maths is valued. A little wall space can go a long way.

C. Arrangement of Furniture

Teachers like to arrange their classroom for the best benefits to students. Students need to focus on, and see, what is going on in the classroom at any given time. The seating arrangement can help, or impede, a student's learning. No perfect arrangement that meets the demands of all situations exists, but classroom layouts need to change based on what a student needs, and how the learning material is presented. Three overall classroom desk arrangements with variations to cater to rooms of different sizes, the number of students, and also to assist in class functions are in use.

- Traditional Classroom (Large or Small)
- U-Shaped Layout
- Circle or Half Circle Arrangements

D. Resources

- General Maths: Resources for all grades including links to large Maths sites, interactive Maths activities, lesson plans, web quests, converters, calculators, virtual manipulatives, prime number generators, fractions and ratios, worksheet generators, vocabulary problems, tables and formulas suitable for a particular grade.
- Elementary Maths: Cover basic subjects, including whiteboard resources, online quizzes, online activity links, and printable tests and worksheets.
- Secondary School level Maths: Cover basic subjects including Algebra, Calculus, and Trigonometry, and Geometry, history of Maths, Power Point unit topics, lesson plans, scatter plots, spread sheets and graphing calculators.
- Special topics: Maths activities related to number sense, concepts, and operations, fractions, measurement, spatial sense, data analysis, probability, and Algebra.
- All about money: Activities for all grades: income tax, allowances and budgeting.

E. Colour

As schools are being built, or remodeled, literally thousands of issues have to be addressed. Unfortunately, colour, especially the colour of classroom walls, is often overlooked. “For budget reasons, a lot of schools don’t seek out good information on colour,” says Bonnie Krims, IACC, architectural colour consultant with Bonnie Krims’ Colour studio in Concord, Mass. “In a lot of cases, colour choices are left up to administrators, teachers, or the maintenance departments. As a result, a lot of walls just end up white, which can lead to under stimulation.”

F. Air circulation and ventilation

A constant flow of fresh air is essential to create an effective learning environment, bringing many benefits to both students and teachers in terms of comfort and performance; a great way to achieve this is by installing school windows natural ventilation. Innovative rapid vent windows can help in education.

- Well-ventilated classrooms improve student performance.
- Poor classroom ventilation can lead to increase in illnesses.
- Naturally ventilated school windows are cost effective.
- Introducing natural ventilation does not mean compromising safety.

G. Temperature

Temperature in a classroom is a dynamic that is difficult to control, but plays a large part in keeping students engaged. Too cold or too warm a classroom can make students sluggish or inattentive. In addition, poor circulation of air causes dust or air pollution that can affect students' allergies.

H. Lighting

Along with sound, light plays a major role in determining whether or not a student is productively engaged in the lesson. The majority of schools use fluorescent lighting. These create a distracting buzz, and make it difficult for someone who prefers natural lighting. It is understandable that some classrooms do not have the opportunity to use natural lighting.

I. Acoustics

Environments that have learner friendly acoustics support some of the key learning processes which include communication, student collaboration, negotiation, and general social competences. The quality of sound genuinely affects the educational outcomes from the perspectives of student and teacher both. A student's ability to hear and to understand what is being said in the classroom is vital for learning. Unfortunately, this suffers in a noisy classroom. Poor classroom acoustics occur when the background noise and/or the amount of reverberation in the classroom are so high that they

interfere with learning and teaching. It is understood that poor classroom acoustics affect,

- Understanding of the spoken word,
- Reading and spelling ability,
- Behavior in the classroom,
- Attention,
- Concentration,
- Academic achievement.

J. Seating Arrangements

The final modification for a classroom that is used by many teachers is the student seating arrangement. The adaptations in seating in teaching/learning impact on the success and motivation of the students in a class. Numerous different ways to organise seating in the classroom are possible. Pairing this skill along with the organisation of how desks are arranged, greatly increases student productivity. A teacher must be mindful of not only where in the room a student is seated, but also by/with whom they are seated. Students may be seated according to so many different arrangements; students are seated according to behaviour, interests, cognitive abilities, or randomly. Each has its own benefit.

K. Class Size

Studies about class size examine how class size influences student and teacher behaviours. In general, smaller classes are associated with students who are less stressed, and are on-task more frequently, with fewer reported behaviour problems than students in larger classes. Although teachers tend to use similar instructional strategies whether teaching large or small classes, evidence suggests that more class time is spent on administrative tasks in larger classes, leaving less time available for instruction. Some research suggests that differences in academic outcomes based on class size are due to differences in student behaviour.

CHAPTER 03

Exploration of Low Mathematics Results

3.1 Research Design

The research design and the research model, variables, indicators, and variable associations of the research model, too, are elaborated. The hypothesis is tested through the empirical survey. The development of the research instrument, i.e. questionnaires and how questions are framed to focus on the mind, receives attention. An attempt is made to narrow down the research area to a manageable level in order to keep a balance in the research topic and its symmetrical nature. This, therefore, limits the accessible field. Accordingly, teaching methods and classroom atmosphere affecting student achievements (x variable) are chosen as the conceptual body of the research on which an empirical survey is done. Student achievements (x variable) is the theoretical phenomenon through which a large volume of theoretical background is framed, as given in the first and second chapter in chronological order; the theoretical frame is developed accordingly.

Teaching methods and classroom atmosphere are recognised as the factors affecting student achievements.

Data Collection

Data is gathered by means of a questionnaire largely made up of close-ended questions. The questionnaire reaches many respondents who study at widely distributed schools and preserves anonymity which encourages greater honesty. The questionnaire is administered at various schools and collected after a week through the Heads of schools. Data collected with the questionnaires yields descriptive statistics around the variables and inferential implications derived from them are recorded.

Methods

The study employed quantitative methodology. Quantitative methodology is useful in this study because it enables the researchers to survey 100 OL

students' perceptions on causes of low achievements in Mathematics. The target population comprises 100 students. The study employs a simple random sampling technique to select the respondents, because this approach provides every student an equal opportunity of participating in the study.

Sampling and Scope

A sample of 100 OL school candidates, who offered Mathematics as one of the subjects, was selected from 10 schools in the Polonnaruwa Education division to answer the questionnaire.

a. Procedures and Techniques

A Quit questionnaire is used to collect data; it is a powerful tool, and the best for acquiring data. The field enumeration is conducted over approximately two months. To administer the questionnaire, a population consisting of students is chosen as follows. Equal opportunities are given to each student of the selected school to be included in the sample, identified through a random number table. Due to the level of homogeneity, only 100 students from the selected schools are chosen. An attempt is made to choose 100 as the sample. Students are considered the primary units for the survey, as they are aware of the situation that exists; the situation is very well known to them as they all sat the OLs. Every attempt is made to meet students at their homes. The questionnaire is structured according to the theoretical model used. Twenty indicators are used to develop the necessary questions where each indicator is well defined in the conceptual framework of the research. The variables are associated with the questionnaire.

b. Validity of the Sample

One hundred students are randomly selected from 10 schools. Therefore, the validity of views expressed is expected to be high; every attempt is made to select the respondents without bias.

c. Reliability and Accuracy

Reliability is assumed to be 100% because of the time taken for the survey. Data is collected by the researcher in person. Every attempt is made to obtain data which is 100% accurate.

Sources

Data is gathered from a variety of sources. Data sources typically fall into one of two broad categories: primary and secondary. Potential primary data sources are Educational Zone Office, subject instructors and students. Higher the percentage, greater the influence on the given factor in each table. The following table shows how views manifest themselves on the scale and how the score value is generated.

3.2 Data Presentation

The following Table 1- 20 explains how different variables perform according to the data collected through the questionnaire.

TABLE 01: Views of respondents about influence

Status of the views	%	Lickert Scale Value	Score
Very high positive influence	40	2	80
Low positive influence	10	1	10
Nil influence	0	0	0
Low negative influence	10	-1	-10
Very low negative influence	40	-2	-80

In table 01 40% respondents indicate that the relevant factor is very influential; 40% disagree. Higher the percentage, greater the influence on the given factor in each table. Ten percent indicate that the factor is influential to some extent. The balance 10% respondents disagree to a certain extent. Accordingly, the given factors are found to be neither influential nor uninfluential as the mean has taken a Zero value. This indicates that the given factor is neutral. Therefore, the mean score has an ability to indicate the strength of the views towards the 'Y' variable. Data is presented in tabular form, too.

Students are selected from different schools in the Polonnaruwa Education Zone. As indicated in the methodology, views are obtained by means of structured questionnaires. Questionnaire 1 is on teaching methods while questionnaire 11 is on classroom atmosphere.

Both questionnaires are structured in accordance with the research model. Relevant questions in Questionnaire I are focused on teachers, in order to measure the teaching skills, and the questions attempt to ascertain to what extent they follow essential methods when they develop teaching processes.

Questions in Questionnaire II are on classroom atmosphere in order to measure the actual conditions and how they contribute.

TABLE 02: Classroom Atmosphere

Status	%	Lickert Scale Value	Score
Use visuals in the classroom on regular basis	50	2	100
Use visuals in the classroom on irregular basis	14	1	14
No idea on the matter	5	0	0
Do not use visuals	12	-1	-12
Do not use visuals at all	19	-2	-38
Mean score = 64/100 = 0.64			

Standard Deviation 1.61

In table 02, 50% of the respondents indicate that visuals are used regularly in the class, while 14% indicate that visuals are used irregularly. Twelve percent indicate that visuals are not used, and 19% indicate that visuals are not used at all. However, 5% do not express any opinion.

TABLE 03: Opinion of Participants

Status	%	Lickert Scale Value	Score
Connection with students in the classroom on regular basis	7	2	134
Connection with students in the classroom on irregular basis	7	1	7
No idea on the matter	6	0	0
Do not have connection with students	17	-1	-17
Do not have connection with students at all	3	-2	-6
Mean score = 118/100 = 1.18			

Standard Deviation 1.28

In table 03, 67% of respondents indicate that connection with students in the class is regular, while 7% indicate that connection with students in the class is irregular. Seventeen percent indicate the absence of connection with students; 6% indicate the absence of any connection at all. Six percent express no opinion.

TABLE 04: Opinion about Assessments

Status	%	Lickert Scale Value	Score
Use assessments in the classroom on regular basis	76	2	152
Use assessments in the classroom on irregular basis	20	1	20
No idea on the matter	0	0	0
Do not use assessments in the classroom	4	-1	-4
Do not use assessments in the classroom at all.	0	-2	0
Mean score = 168/100 = 1.68			

In table 04, 76% indicate that the use of assessment in class is regular; 20% say it is not regular. Four percent indicate that assessments are not used; 0% indicate that assessment is not used at all; another 0% have no opinion.

TABLE 05: Opinion on Strategic Focus

Status	%	Lickert Scale Value	Score
Focus on strategies in the classroom on regular basis	26	2	52
Focus on strategies in the classroom on irregular basis	27	1	27
No idea on the matter	6	0	0
Do not focus on strategies in the classroom	23	-1	-23
Do not focus on strategies in the classroom at all	18	-2	-36
Mean score = 20/100 = 0.20			

Standard Deviation 1.48

In table 5, 26% of respondents indicate that strategies are used in class regularly, while 27% indicate that strategies are irregular in use. Twenty three indicate that strategies are not a focus in the class; 18% indicate strategies are not used at all. Six percent express no opinion.

TABLE 06: Strategies in Teaching

Status	%	Lickert Scale Value	Score
Teach a limited number of maths facts in the classroom on regular basis	63	2	126
Teach a limited number of maths facts in the classroom on irregular basis	11	1	11
No idea on the matter	13	0	0
Do not teach a limited number of maths facts in the classroom	12	-1	-12
Do not teach a limited number of math facts in the classroom at a time	1	-2	-2
Mean score = 123/100 = 1.23			

Standard Deviation 1.13

In table 06, 59% of respondents indicate that a limited number of Maths facts is taught in the class regularly; 13% indicate that a limited number of maths facts is taught on an irregular basis, while another 13% indicate that a limited number of math facts is not taught in the class. One percent indicate that a limited number of math facts is not taught in the class at all. However, 15% percent express no opinion.

TABLE 07: Classroom Engagements on Cumulative Practices

Status	%	Lickert Scale Value	Score
Develop cumulative practice in the classroom on regular basis	32	2	64
Develop cumulative practice in the classroom on irregular basis	8	1	8
No idea on the matter	7	0	0
Do not have developed cumulative practice in the classroom	34	-1	-34
Do not have developed cumulative practice in the class room at all	19	-2	-38
Mean score = 0/100 = 0			

Standard Deviation 1.56

In table 07, 32% of respondents indicate that cumulative practice is developed in the class on a regular basis; 8% say cumulative practice is developed in the class on an irregular basis, while 34% indicate that cumulative practice is not developed in the class, and 19% indicate that cumulative practice is not developed in the class at all. However, 7% express no opinion.

TABLE 08: Use of Verbalized Thinking

Status	%	Lickert Scale Value	Score
Use verbalized thinking in the classroom on regular basis	50	2	100
Use verbalized thinking in the classroom on irregular basis	25	1	25
No idea on the matter	3	0	0
Do not use verbalized thinking in the classroom	12	-1	-12
12 Do not use verbalized thinking in the classroom at all	10	-2	-10
Mean score = 103/100 = 1.03			

Standard Deviation 1.38

In table 08, 50% indicate that verbalized thinking is practiced in the class on a regular basis; 25% indicate that verbalized thinking is practiced in the class on an irregular basis, while 12% indicate that verbalized thinking is not practiced in the class. Ten percent indicate that verbalized thinking is not practiced in the class at all. However, 3% express no opinion.

TABLE 09: Classroom Feedback Sessions

Status	%	Lickert Scale Value	Score
Necessary feedback in the classroom on regular basis	32	2	64
Necessary feedback in the classroom on irregular basis	23	1	23
No idea on the matter	6	0	0
Do not have necessary feedback in the classroom	33	-1	-33
Do not have necessary feedback in the classroom at all	6	-2	-12
Mean score = 42/100 = 0.42			

Standard Deviation 1.37

In table 09, 32% indicate that necessary feedback is given/received in the class on a regular basis; 23% indicate that necessary feedback is given/received in the class on an irregular basis, while 33% indicate that necessary feedback is not given/received in the class, and 6% indicate that necessary feedback is not given/received in the class at all. However, 6% express no opinion.

TABLE 10: Use of Presentations and Explanations

Status	%	Lickert Scale Value	Score
Use presentation and explanation in the classroom on regular basis	49	2	98
Use presentation and explanation in the classroom on irregular basis	24	1	24
No idea on the matter	7	0	0
Do not use presentation and explanation	16	-1	-16
Do not use presentation and explanation in the class room at all	4	-2	-8
Mean score = 98/100 = 0.98			

Standard Deviation 1.24

In Table 10, 49% indicate that presentation and explanation are practiced in the class on a regular basis; 24% say that presentation and explanation are practiced in the in the class on an irregular basis. Sixteen percent say presentation and explanation are not practiced in the class, and 4% indicate that presentation and explanation are not practiced in the class at all. However, 7 % do not express any opinion.

TABLE 11: Use of Group Work

Status	%	Lickert Scale Value	Score
Build group work in mathematics in the classroom on regular basis	37	2	74
Build group work in mathematics in the classroom on irregular basis	10	1	10
No idea on the matter	9	0	0
Do not build group work in mathematics presentation and explanation	32	-1	-31
Do not build group work in mathematics in the classroom at all	12-	-2	-24
Mean score = 28/100 = 0.28			

Standard Deviation 1.51

In Table 11, 37% say that group work is utilized in teaching/learning mathematics on a regular basis; 10% say that group work is utilized in teaching/learning mathematics on an irregular basis, while 32% say that group work is not utilized in teaching/learning mathematics, and 12% say that group work is utilized in teaching/learning mathematics. However, 9% have no opinion.

TABLE 12: Use of Wall - Art

Status	%	Lickert Scale Value	Score
Use wallcharts	30	2	60
Use wallcharts to some extent	17	1	17
No idea on the matter	5	0	0
Do not use wallcharts	19	-1	-19
Do not se wallcharts at all	29	-2	-58
Mean score = 0/100 = 0			

Standard Deviation 1.64

In Table 3.6. 30% of respondents say that displays of wallcharts to focus the attention of the students are used well; 17% say that such displays are used to some extent, while 19% say these are not used. Twenty nine percent say that such wallcharts are not used at all, however, 5% do not express any opinion.

TABLE 13: Arrangement of Classroom Furniture

Status	%	Lickert Scale Value	Score
Arrangement of desks in the classroom benefits students very well	40	2	80
Arrangement of desks in the classroom benefits students to some extent	22	1	22
No idea on the matter	8	0	0
Do not have arrangement of desks to benefits students	12	-1	-12
Do not have arrangement of desks in the classroom to benefits students at all	18	-2	-36
Mean score = $54/100 = 0.54$			

Standard Deviation 1.53

In table 13, 40% say that particular arrangement of furniture benefit the students very well, while 22% say that they benefit students to some extent. However, 12% indicate that such arrangements have no benefits, while 18% indicate that there are no benefits at all. Eight percent of the respondents have no opinion.

TABLE 14: Use of Resources

Status	%	Lickert Scale Value	Score
Resources are well provided to students in the classroom	35	2	70
Resources are provided in the classroom to some extent.	16	1	16
No idea on the matter	7	0	0
Do not provide resources	34	-1	-34
Do not provide resources in the classroom at all	8	-2	-16
Mean score = $36/100 = 0.36$			

Standard Deviation 1.38

In table 14, 35% say that classes are well provided with resources, 16% say classes are provided with resources to some extent, while 34% indicate that resources are not provided and 8% indicate that resources are not provided at all. However, 7% hold no opinion.

TABLE 15: Use of Colours

Status	%	Lickert Scale Value	Score
Classroom colour stimulates students	30	2	60
Classroom colour stimulates students to some extent	30	1	30
No idea on the matter	6	0	0
Classroom colour does not stimulates students	23	-1	-23
Classroom colour does not stimulate students at all	11	-2	-22
Mean score = $45/100 = 0.45$			

Standard Deviation 1.25

In table 15, 30% of respondents indicate that the colour of the classroom stimulates the students very well, while another 30% indicate that the colour of the classroom stimulates the students to some extent, however, 23% indicate that the colour of the classroom does not stimulate the students, while 11 % hold that the colour of the classroom does not stimulate the student at all. However 6% respondents hold no opinion.

TABLE 16: Air Circulation and Ventilation in the Classroom

Status	%	Lickert Scale Value	Score
Air circulation and ventilation in the classroom affects learning environment very well	45	2	90
Air circulation and ventilation in the classroom affects learning environment to some extent	20	1	20
No idea on the matter	14	0	0
Air circulation and ventilation in the classroom do not affect learning	12	-1	-12
Air circulation and ventilation in the classroom does not affect environment at all	9	-2	-18
Mean score = $80/100 = 0.8$			

In table 16, 45% say the air circulation and the ventilation available in the classroom stimulate the students very well, however, 20% indicate that the air circulation and the ventilation available stimulate the students to some extent. Twelve percent say the air circulation and the ventilation available in the classroom do not stimulate the students, and 9% indicate that the air circulation and the ventilation available in the classroom do not stimulate the students at all. However, 14% express no opinion.

TABLE 17: Temperature in the Classroom

Status	%	Lickert Scale Value	Score
Classroom temperature is affects learning	24	2	48
Classroom temperature affects learning to some extent	23	1	23
No idea on the matter	10	0	0
Classroom temperature dose not affects learning	28	-1	-28
Classroom temperature dose not affect learning at all	15	-2	-30
Mean score = 13/100 = 0.13			

Standard Deviation1.43

In table 17, 24% indicate that effective learning is related to the controlled temperature in the classroom 23% say that effective learning is related to the controlled temperature in the classroom to some extent, while 28% indicate that effective learning is not related to the controlled temperature in the classroom and 15% indicate that effective learning is not at all related to the controlled temperature in the classroom. However, 10% have no opinion.

TABLE 18: Use of Suitable Light in the Classroom

Status	%	Lickert Scale Value	Score
Lighting provided in the class affects productive learning very well	51	2	102
Lighting provided in the classroom affects productive learning to some extent	21	1	21
No idea on the matter	5	0	0
Lighting in the classroom does not affect productive learning	16	-1	-16
Lighting in the classroom does not affect productive learning at all	7	-2	-14
Mean score = 93/100 = 0.93			

Standard Deviation 1.35

In table 18, 51% indicate that lighting available in the classroom creates a productive learning environment very well; 21% say that it does to some extent, while 16% say that lighting available in the classroom does not create a productive learning environment in the classroom, and 7% indicate that lighting in the classroom does not create a productive learning environment at all. However, 5% hold no opinion.

TABLE 19: Acoustics in the Classroom

Status	%	Lickert Scale Value	Score
Acoustics in the classroom affect educational outcomes very well	30	2	40
Acoustics in the classroom affect educational outcomes to some extent	24	1	24
No idea on the matter	10	0	0
Acoustics in the classroom do not affect educational outcomes	21	-1	-21
Acoustics in the classroom do not affect educational outcomes at all	15	-2	-30
Mean score = $33/100 = 0.33$			

Standard Deviation 1.46

In table 19, 30% say acoustics in the classroom enhance educational outcomes very well; 24% say that acoustics enhance educational outcomes to some extent, while 21% indicate that acoustics do not enhance educational outcomes, and 15% that acoustics in the classroom do not enhance educational outcomes at all. However, 10% do not hold any opinion.

TABLE 20: Organized Seating Arrangements

Status	%	Lickert Scale Value	Score
Organized seating arrangements in the classroom match large impacts on the success and motivation of the students very well	28	2	56
Organized seating arrangements in the classroom match large impacts on the success and motivation of the students to some extent	38	1	38
No idea on the matter	13	0	0
Organized seating arrangements in the classroom do not match large impacts on the success and motivation of the students	13	-1	-13
Organized seating arrangements in the classroom do not match large impacts on the success and motivation of the students at all	8	-2	-16
Mean score = 65/100 = 0.65			

Standard Deviation 1.23

In table 20, 28% of respondents say that seating arrangements in the classroom impact on the success and motivation of the students very well; 38% indicate that seating arrangements in the classroom impact on the success and motivation of the students to some extent, and 13% indicate that seating arrangements in the classroom do not impact on the success and motivation of the students. Eight percent say that seating arrangements in the classroom do not impact on the success and motivation of the students at all. However, 13% express no opinion.

TABLE 21: Classroom Size

Status	%	Lickert Scale Value	Score
Class size matches with academic outcomes very well	26	2	52
Class size matches with academic outcomes to some extent	24	1	24
No idea on the matter	19	0	0
Class size does not match with academic outcomes	25	-1	-25
Class size does not match with academic outcomes at all	6	-2	-12
Mean score = $39/100 = 0.39$			

Standard Deviation 1.26

In table 21, 26% indicate that class size affects academic outcomes very well, while 24% say class size affects academic outcomes to some extent, and 25% say class size does not affect academic outcomes, and 6% indicate that class size does not affect class size at all. However, 19% have no opinion.

CHAPTER 04

Examining Issues

4.1 Use of Teaching Methods and Improving Classroom Culture

The following section explains how the indicators and variables have performed in achievement of low Mathematics results.

TABLE: 21 Effect and the Level of Significance of Each Indicator in Connection with Teaching Methods.

No.	Indicator	Mean value	Standard Deviation	Variable effect	Level of significance
1	Mathematics teacher uses visuals	0.64	1.61	Variable influences to some extent the low achievements in mathematics	Significant
2	Mathematics teacher connects with students	1.18	1.28	Variable has low influence on low achievements in mathematics	Insignificant
3	Mathematics teacher uses assessments	1.68	0.45	Variable influence extremely high on low achievements in the mathematics	Significant
4	Mathematics teacher focuses on strategies	0.2	1.48	Variable influence very low low achievements in mathematics	Insignificant
5	Mathematics teacher teaches a limited number of math facts	1.23	1.13	Variable influence low achievements in mathematics	Insignificant
6	Mathematics teacher develops cumulative practice	0	1.56	Variable influence very low on low achievements in mathematics	Insignificant
7	Relevant procedures are made by teacher in order to match <u>Verbalized thinking</u>	1.03	1.38	Variable influence low on low achievements in mathematics	Insignificant
8	Necessary feedback is given by mathematics teacher	0.42	1.37	Variable influence very low on low achievements in mathematics	Insignificant
9	Mathematics teacher has high skills of Presentation and explanation	0.98	1.24	Variable influences low on achievements in mathematics to some extent	Insignificant
10	Mathematics teacher uses group work in mathematics	0.28	1.51	Variable influence very low on low achievements in mathematics	Insignificance

TABLE 22: Effect and the Variable Significance of each Indicator in Connection with Class Atmosphere

No	Indicator	Mean value	Standard Deviation	Variable effect	Level of significance
1	Wallcharts in the class room.	0	1.64	Variable influence very low on low achievements in mathematics	Insignificant
2	Arrangement of desks in the classroom	0.54	1.53	Variable very low influence on increasing mathematics achievements	Insignificant
3	Resources are well provided to students	0.36	1.38	Variable influenced very low on low in achievements in mathematics	Insignificant
4	Colour of the classroom.	0.45	1.25	Variable influence very low on low achievements in mathematics	Insignificant
5	Air circulation and ventilation in the classroom	0.8	1.35	Variable influences on low achievements in mathematics to some extent	Significant
6	Temperature in the classroom	0.13	1.43	Variable influence very low on low achievements in mathematics	Insignificant
7	Lighting in the classroom	0.93	1.35	Variable influences low achievements in mathematics to some extent for the	Significant
8	Acoustics in the classroom	0.33	1.46	Variable influence on low achievements in mathematics very low to some extent	Insignificant
9	Seating arrangements in the classroom	0.65	1.23	Variable influenced low achievements in mathematics to some extent	Significant
10	Class size affects academic outcomes	0.39	1.26	Variable influence very low on low achievements in mathematics	Insignificant

CHAPTER 05

Mathematics Performance and Pertaining Challenges

5.1 Identified Issues

Sri Lanka's economic and social development relies on a highly skilled population. Living a fulfilling and productive life is increasingly challenging for individuals without minimum skills in numeracy and literacy. A certain level of knowledge of Mathematics, Science, and Technology is essential for successful participation in the various spheres of modern society. The current position where more than 20% of Sri Lankan youth do not reach a minimum skill level in Mathematics is alarming, and untenable.

According to statistics published by the Ministry of Education, the failure rate of school candidates in the Polonnaruwa Education Zone in Mathematics is,

2009	-	52.29%
2010	-	40.48%
2011	-	46.76%
2012	-	45.88%
2013	-	44.07%
2016	-	42.77%

According to data released by the Department of Examinations, an average of only 55% of the combined total of school and private candidates passed in OL Mathematics in the years 2011, and 2012. In addition, the mean scores have been in the low range of 32%. This disconcerting national trend tempts one to conclude that our students are ill prepared to compete in today's knowledge economy.

Table 23 shows the percentages of candidates who failed in Mathematics at the OLs in Polonnaruwa Educational Zone in the recent past. Most of the candidates fail the OLs due to their failure in Mathematics.

**TABLE 23: Percentages of Failures in Mathematics
at O/Ls from 2009 to 2015**

Year	2009	2010	2011	2012	2013	2014	2015
Number of students sat for Mathematics paper	1968	1803	1818	1786	1313	1540	1639
Number of failures	1038	706	889	839	649	580	746
Failure Percentage	52.74	39.15	48.89	46.97	49.42	37.66	45.51

The failure rate from 2009 to 2015, which is significantly higher than 40%, is alarming. However, after 2009, this improved to a figure which is marginally below 46%. Nevertheless, the failure rate in Mathematics is still unacceptably high. As this leads to grave social repercussions by leaving a large percentage of youth without viable future plans, urgent remedial measures must be initiated as early as possible. Identification of factors related to results in Mathematics is essential in this regard.

Table 24 shows the percentages of candidates who failed in Mathematics at the O/Ls in the recent past in Sri Lanka. Most of the candidates fail the O/Ls due to their failure in Mathematics.

**TABLE 24: Percentages of Candidates who Failed in Mathematics at the
O/Ls from 2009 to 2015**

Year	2009	2010	2011	2012	2013	2014
Number of students sat for Mathematics paper	271,611	367,697	348,143	352,475	287,040	277,414
Number of failures	133,117	140,969	145,907	132,566	102,732	92,795
Failure Percentage	49.01	38.34	41.91	37.61	35.79	33.45

The failure rate from 2009 to 2014, which was alarming, and significantly higher than 35%, improved to a figure which is marginally below 40%, between 2009 and 2015. Nevertheless, the failure rate in Mathematics is still unacceptably high. Since this leads to grave social implications by leaving a large percentage of youth without any viable future plan, remedial measures must be initiated as urgently as possible. Identification of factors related to the results in Mathematics is essential for this purpose.

TABLE 25: Percentages of Failures in Mathematics among Candidates who sat the OLs for the first time from 2010 District wise.

District	Number of students sat for Mathematics paper	Number of failures	Failure Percentage
Colombo	29076	8013	27.56
Gampaha	24669	8861	35.92
Kaluthara	13893	4909	35.33
Kandy	19705	8050	40.85
Mathale	6612	3174	48.00
Nuwaraeliya	9616	4858	50.52
Galle	15390	5701	37.04
Mathara	11710	4428	37.81
Hambanthota	9184	3801	41.39
Jaffna	8666	3421	39.48
Kilnocchi	2061	1234	59.87
Mannar	1401	640	45.68
Vauniya	2705	1043	38.56
Mulathivu	1566	916	58.49
Batticaloa	6261	2543	40.62
Ampara	9037	3178	35.17
Trincomalee	5435	2377	43.74
Kurunegala	21720	7747	35.67
Putthalam	9464	3960	41.84
Anuradhpura	11805	5412	45.84
Polonnaruwa	5411	2650	48.97
Badulla	12162	5387	44.29
Monaragala	7072	3875	54.79
Rathnapura	14632	6541	44.70
Kegalle	11002	4361	39.64
All Island	270255	107080	39.62

5.2 The Emergence of the Issue: Documentary Evidence

Tables 26 – 30 to 8 show the percentages of candidates who failed in Mathematics at the OLs in the recent past in the Polonnaruwa district Educational Zone. Most of the candidates fail the OLs due to their failure in Mathematics.

(Source: Results reports of Department of Education-NCP)

TABLE 26: Percentages of Failures in Mathematics in Different Educational Zones among Candidates who sat the OLs for the first time in 2009.

Educational Zone	Number of students sat for Mathematics paper	Number of failures	Failure Percentage
Polonnaruwa	1744	912	52.29
Hingurakgoda	2433	1463	60.13
Dimbulagala	1664	1160	69.71
All Island	271611	133139	49.02

TABLE 27: Percentages of failures in Mathematics in different Educational Zones among candidates who sat the OLs for the first time in 2010.

Educational Zone	Number of students sat for Mathematics paper	Number of failures	Failure Percentage
Polonnaruwa	1650	668	40.48
Hingurakgoda	2222	1113	50.09
Dimbulagala	1539	869	56.47
All Island	270255	107080	39.62

TABLE 28: Percentages of failures in Mathematics in different Educational Zones

Educational Zone	Number of students sat for Mathematics paper	Number of failures	Failure Percentage
Polonnaruwa	1649	771	46.76
Hingurakgoda	2086	1209	57.29
Dimbulagala	1500	954	63.60
All Island	269167	120227	44.67

Percentages of failures in Mathematics in different Educational Zones among candidates who sat the OLs for the first time in 2012.

Educational Zone	Number of students sat for Mathematics paper	Number of failures	Failure Percentage
Polonnaruwa	1565	718	45.88
Hingurakgoda	2034	1143	56.19
Dimbulagala	1422	771	54.22
All Island	267858	119597	44.65

TABLE 29 : Air Circulation and Ventilation in the Class-room

Status	%	Lickert Scale Value	Score
Air circulation and ventilation in the classroom matches the effective learning environment very well	45	2	90
Air circulation and ventilation in the classroom matches the effective learning environment some to extent	20	1	20
No idea on the matter	14	0	0
Do not have designed air circulation and ventilation in the classroom to affect the learning environment	12	-1	-12
Do not have designed air circulation and ventilation in the classroom to affect the learning environment at all	9	-2	-18
Mean score = 80/100 = 0.8			

Percentages of failures in Mathematics in different Educational Zones among candidates who sat the OLS for the first time in 2013.

TABLE 30 : Failures in the Polonnaruwa Educational Zone

Educational Zone	Number of students sat for Mathematics paper	Number of failures	Failure Percentage
Polonnaruwa	1602	706	44.07
Hingurakgoda	2065	1068	
Dimbulagala	1392	780	56.03
All Island	264172	112982	42.77

CHAPTER 06

Recommendations to Overcome Low Achievements in Mathematics

6.1 Critical Observations

Today, measuring achievements in Mathematics becomes an important issue to most educational establishments. Empirical evidence in literature suggests that there is a very high correlation between teaching methods and student achievements. Teachers of Mathematics have a nuanced job. They must motivate students, and teach them to persevere when problems challenge them. The relationship between the learning environment, and attitude towards Mathematics is significant. Students with a better perception of the learning environment and a more positive perception of their teachers have more positive attitudes towards Mathematics. It is necessary to improve educational service quality, and the perceived value in learning to lead students to achieve better performance, and to reach for a better future. It is paramount; this would result in better relationships with every student.

This study is of use to relevant organisations and officers in providing guidance on developing practices, and modifying the existing practices of measuring student achievements in schools. The research emphasises strategies, and suggests and recommends means for maximizing student Mathematics achievements by identifying the causative dynamics, and assessing the degree of influence these exert on Mathematics achievements.

Student Mathematics achievements vitally affect the future of students. The research concludes that the effects of teaching methods and classroom atmosphere bear on Mathematics achievements by students. Subsequent to analysis of teaching methods and the classroom atmosphere, student Mathematics achievements are recognised as the dependent variable, while teaching methods and classroom atmosphere is considered as the independent variable. A research model based on literature is developed. The survey method is adopted to collect data through a structured questionnaire. The sample is selected using the stratified random sampling method.

A strong relationship between service quality in teaching methods and the classroom atmosphere is identified. These dynamics impact on student satisfaction.

6.2 Recommendations

Research reveals that the use of visuals in the class affects Mathematics achievements. In statistical analysis, the Lickert mean takes a positive value of 0.64. Therefore, the factor is positive and on the other hand, the SD value of 1.6 indicates that it is significant to some extent. Therefore, it is identified that the use of visuals in the classroom affects student Mathematics achievements.

It is recommended that teachers use visuals in the classroom. Their use enhances student Mathematics achievements. The impact of the mathematics teacher's connectivity with students too, is significant. Mathematics teachers are the able to establish connectivity with students.

Since students perceive that teachers are reliable, the present research recommends that the teachers continue the process of developing connectivity with students on a regular basis in order to receive feedback about mathematics achievements.

6. 2.1 The Impact of Assessment

Research reveals that assessments in the classroom affect Mathematics achievements. In statistical analysis, the Lickert mean takes a high positive value of 1.68. Therefore, the factor is positive; on the other hand, the SD value of 0.45 indicates that it is significant to an extremely high degree. Therefore, assessments in the classroom affect student Mathematics achievements. Accordingly, the use of assessments in the class is recommended. This enhances student Mathematics achievements.

6. 2. 2 Strategies

Mathematics teachers use strategies to help students. The present research recommends the continued use of strategies with students on a regular basis in order to receive feedback from students on Mathematics achievements.

Mathematics teachers teach a limited number of Math facts to the students. The present research recommends that teachers continue to focus on strategies on a regular basis in order to receive the opinion of students on Mathematics achievements. Mathematics teacher have developed cumulative practice.

The present research recommends that teachers continue using cumulative practice in the class on a regular basis in order to receive the opinion of students about Mathematics achievements.

a) Verbalised Thinking

Mathematics teachers have developed relevant procedures in order to promote verbalised thinking in the class. The research recommends teachers to continue the process of following relevant procedures to promote verbalised thinking in the class on a regular basis in order to receive the opinion of students about Mathematics achievements.

b) Feedback

Teachers have practiced giving/receiving necessary feedback in their classes.

The present research recommends teachers continue the process of giving/receiving necessary feedback in the classroom on a regular basis in order to receive students' opinions about Mathematics achievements.

c) Presentation and Explanation

Mathematics teachers have employed a high degree of skill in presentation and explanation in the class. The present research recommends that teachers continue the use of presentation and explanation in the class on a regular basis in order to receive students' opinions about Mathematics achievements.

d) Group work in Mathematics

Mathematics teachers have practiced the use of group work in Mathematics in the class. The research recommends that teachers continue using group work in Mathematics on a regular basis in order to receive students' opinions about Mathematics achievements.

Use of Wallcharts

e) Mathematics Teachers use Wallcharts in Classrooms

The research recommends that teachers continue to use wall charts in the teaching of Mathematics on a regular basis in order to receive opinions about mathematics achievements from students.

f) Arrangement of Furniture in the Classroom

The Mathematics teachers use arrangements of furniture that benefit students. The research recommends that Mathematics teachers continue the same procedure in the arrangement of furniture in the classroom on a regular basis in order to receive the opinion of students about Mathematics achievements.

g) Resources

The Mathematics teachers provide resources to the students. The research recommends that teachers continue the same practice of providing resources to the students on a regular basis in order to receive the opinion of students about Mathematics achievements.

h) Colour

Colours that enhance learning are used by the management of the school. The research recommends that this practice be continued on a regular basis in order to receive the opinions of students about Mathematics achievements.

i) Air Circulation

According to the findings it is ascertained that air circulation and ventilation in the classroom affect Mathematics achievements. It is recommended that school management continues to maintain air circulation and ventilation in the classroom. It enhances Mathematics achievements among students.

Temperature

School management controls the temperature in the classroom. The research recommends that the school management continues the process of controlling the temperature in the classroom on a regular

basis in order to receive the opinion of students about Mathematics achievements.

j) Temperature

School management controls the temperature in the classroom. The research recommends that the school management continues the process of controlling the temperature in the classroom on a regular basis in order to receive the opinion of students about Mathematics achievements.

k) Lighting

Research reveals that the lighting in the classroom affects performance in Mathematics. In statistical analysis, the Lickert mean takes a positive value of 0.93. Therefore, the factor is positive and on the other hand, the SD value of 1.35 indicates that it is significant to some extent. Therefore, the conclusion is that lighting in the classroom affects students' Mathematics achievements. It is recommended that the management of the school improves the lighting in the classroom. This enhances student Mathematics achievements.

l) Acoustics

The school management controls acoustics in the classroom. The research recommends that school management continues this process of controlling acoustics in the classroom on a regular basis in order to receive opinions of students about Mathematics achievements.

m) Seating arrangements

Research reveals that seating arrangements in the classroom affect Mathematics performance. In statistical analysis, the Lickert mean takes a positive value of 0.65. Therefore, the factor is positive; on the other hand, the SD value of 1.23 is significant to some extent. Therefore, it is accepted that lighting in the classroom affects student mathematics achievements.

It is recommended that the school management employs productive seating arrangements in the classroom. It enhances student Mathematics achievements.

n) Outcomes vis a vis class size

The school management controls class size. The research recommends that school management continues this process of controlling class size on a regular basis in order to receive the students' opinions about Mathematics achievements.

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