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The Core Curriculum development team is responsible for the choice and presentation of the theories and data contained in this book. Its author takes overall responsibility for the views and opinions expressed in this document.

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## FOREWORD

We are delighted to release our first Core Curriculum, knowing that many of our target beneficiaries would benefit from it. As we tirelessly continue our effort to ensure that we are delivering evidence-based education for all of our target beneficiaries, we hope that our Core Curriculum will offer a robust framework for us to develop high-quality learning games.

Supporting our target beneficiaries to develop the necessary skills useful for the workforce of the future is a challenging task. To achieve our mission, we will always need a data-driven and research-informed team of researchers, educators, technologists, and game developers who are committed to solving education inequality around the world.

That is why we highly appreciate the many people including our team members who have contributed to the process of formulating the Core Curriculum through the preparation of materials and by providing constructive feedback and advice for improvement.

Talitha Amalia Director, Education and Development



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# VISION, MISSION & VALUE

## Vision

## Enable people to empower themselves.

## Mission

Build an open platform that provides everyone access to effective education.

## Value

Education is a basic human right, and everyone should have access to quality and effective education.



# **OVERVIEW**

Solve Education! was founded at the end of 2015 as a nonprofit organisation that focuses on developing new technologies to help young people increase their learning motivation and thrive in the 21st-century knowledge economy<sup>1</sup>. The organisation targets the world's most marginalised young people who are out-of-school and/or fail to access an education which can provide them with the critical thinking and problem-solving skills they need to enter the 21st-century workforce and transform their lives. The children and vouth who are at the highest risk of being left behind are those who face barriers linked to poverty, diversity politics, gender, disability, armed conflict and displacement. Inadequate access to guality education entrenches cycles of inequality by preventing disadvantaged children from attaining the skills to change their economic situation.

Since the organisation's vision is for future generations to have equal access to the knowledge economy, there is an urgent need for an educational framework and platform that are accessible to students regardless of their socio-economic background and geographical and cultural boundaries. Globally, many students without access to quality schooling (about 263 millions) have access to low-end smartphone and broadband technology (70% of the world population by 2020)<sup>2</sup>. Solve Education! leverages the phenomenon of smartphone and broadband penetration to create an educational game app that is hoped to answer the problems with the current education system which perpetuates social inequality. It uses game mechanics and artificial intelligence to provide engaging educational opportunities in the form of a game-based educational application which runs on low-end smartphones and intermittent internet. The game app builds in real-life incentives by directly linking success in the game to opportunities on our online employment platform in the hopes of improving students' income prospects in a knowledge economy.

- Peter Drucker popularised the term knowledge economy in the 1960s, and it refers to the recognition of knowledge that drives the economy. The term 21 st-century knowledge economy used in this context relates to the debate within the education field about how demands in the marketplace of today have influenced the education system and culture around the world. For example, this phenomenon was discussed in the OECD Report in 1996.
- <sup>2</sup> The data is taken from the 10th Annual Cisco Visual Networking Index in 2016.



# BACKGROUND & OBJECTIVES

Since the organisation's founding, Solve Education! is committed to delivering evidence-based education to support young people regardless of their geographical and socio-economic backgrounds to access the 21st-century knowledge economy<sup>3</sup>. To do this, young people need critical, analytical skills, and confidence in their ability to learn, adapt to changes, and solve problems.

Solve Education! realised that the issue above has been long recognised by innovators who often see problems as opportunities. More and more educational technology companies have begun to imagine and design educational products that are only affordable to a particular market. In many cases, current educational innovations perpetuate the cycle of inequality by prioritising the needs of the privileged students who can afford their products and services.

Moreover, there are two significant challenges which have been insufficiently addressed by the educational technology industry. The first of these revolves around learning motivation. The vast majority of the existing products assume users' motivation to learn. Solve Education! understands that when students are marginalised from the current education system, it is nearly impossible to be motivated to learn the skills necessary to thrive in the future. With this in mind, the organisation uses evidence from successful game developers to create a game so engaging that students become addicted to playing, and to learning. Once that motivation has begun to grow, the path is set for students to develop a deeper kind of motivation to become a life-long learner.

The second challenge is about the infrastructure. Most education technology products are created for well-developed broadband networks, running on high-end devices. Most broadband networks in emerging markets are not well developed and the most sophisticated access point is a low-end smartphone. Solve Education! believes that there should be an approach that benefits the majority of the people on the planet. Software systems for ed-tech can be designed to function in low bandwidth, with intermittent connectivity, and using low computer-power. To develop such technology is a challenging task and one which is rarely tackled because of its low monetary returns compared to the provision of ed-tech solutions for markets with a higher disposable income.

### **BACKGROUND & OBJECTIVES**



Solve Education! believes that when one can modify traditional pedagogical approaches to ride on prevalent technologies and broadband networks, one will be able to create a scalable and sustainable approach to education for large numbers of the young, especially the world's most marginalised. To do that, a robust curriculum framework was designed to ensure that students achieve satisfactory learning outcomes.

The core curriculum serves a basis for its pedagogical approach which is delivered to its educational game app. It is designed to help students to become successful independent learners, confident in their ability to learn and solve problems. It also describes to Solve Education!'s content developers what is to be taught and the quality of learning expected of students as they progress in their learning journey. Solve Education! draws on the instructional best practices and modified them to adapt to students' academic and social needs.

3 The changing nature of work that affects education around the world is explained by Tony Bates in his book 'Teaching in a Digital Age' in 2015. Educators are forced to re-examine teaching and learning to better support students to thrive in today's globalised and technology-led society.





# TARGET STUDENTS

Solve Education! targets young people age 15 years old and above as its beneficiaries and prepares them with the knowledge and skills relevant to the 21st-century marketplace.

According to the 2016 UNICEF report on Education, the total number of out of school young people had risen to an estimated 263 millions, including those of upper secondary school-age. Approximately 26 million of them would never enter school, 23 million would begin schooling late, and 12 million have already left school. Based on existing trends, an estimated 69 percent of young people in low-income countries are not expected to learn basic primary-level skills by 2030, contrasted with only 8 percent of young people in high-income countries.

This problem is often exacerbated by the fact that 168 million young people are trapped in child labour. Many of the young people trapped in jobs that fail to offer a fair income, security and safety in the workplace, are the ones who struggle most to access the benefits of education. Solve Education! is committed to providing an opportunity to receive quality education for the world's out-ofschool youth as well as for the millions for whom the traditional means of education are not effective. The focus is driven by the problems and challenges faced by youth around the globe who are marginalised from both education and employment. Young people, especially the out-of-school groups, are more vulnerable to be left behind and trapped in a cycle of poverty. The core curriculum is specifically designed to indicate how important evidence-based education is in changing the lives of these young people. Equipping young people with fundamental knowledge and skills relevant to the workforce of the future is vital to securing the well-being and productivity of individuals, families and societies (ILO, 2015).





# STUDENT'S KEY COMPETENCIES

The Core Curriculum is aimed at inculcating among students the following six key competencies:

## 01.

## Communicative Competence

Students are expected to use a language not only correctly (based on linguistic competence) but also appropriately (based on communicative competence). They need to be able to receive and transmit information based on the context. They need to be able to use proper reasoning and judgement to decide whether particular information is correct. They also need to be able to choose the most effective method of communication for each circumstance they encounter.



## Critical Thinking Skills

Students are expected to analyse and assess thinking with a view to improving it. They need to be able to restructure thinking as a result of investigation and evaluation. To do this, students need to be equipped with the knowledge of the underlying structures in thinking (the elements of thought) and the basic intellectual standards for thinking (universal intellectual standards).

### STUDENT'S KEY COMPETENCIES



# 03.

## Problem Solving Skills

Students are expected to eliminate problems and obstacles using accurate information and proper reasoning. They need to be able to recognise changes in different situations and apply appropriate knowledge to prevent or solve a problem. They also need to be able to make a sound decision by considering the risks and consequences that affect their lives and their surrounding.

# 04.

Collaborative Skills

Students are expected to become capable of working with others to achieve a common goal. They need to participate, exchange ideas and share responsibilities with others. They respect competing views and nurture positive relationships. They need to be adaptable, willing to compromise and value the contributions of others.

## 05.

### Familiarity with New Technologies

Students are expected to be familiar with different new technologies. They need to be able to differentiate, choose, and use these technologies that are relevant to the basic needs in today's marketplace.

# 06.

## Development of Life-skills

Students are expected to apply necessary skills to help them thrive in life. Grit, discipline, and diligence are among other valuable skills for students to possess. These three skills are required for students to excel in learning and to work as well as to strengthen social relationships. After completing their learning journey, students are expected to develop grit, discipline, and diligence so that they can adapt to changing social and job working circumstances.



# KEY DESIGN PRINCIPLES

Solve Education! aims to create a self-regulated educational platform that can increase students' engagement and retention as well as encourage their independent and life-long learning mindset. To achieve that, two key design principles were adopted:

## 01.

### LM-GM Framework for Serious Games

While doing research and modelling in 2016, Solve Education! was inspired by Serious Games design<sup>4</sup>. A serious game (often called an applied game) is an educational technology terminology for a game which has a purpose other than just pure entertainment. Serious games have been recognised by the scientific community to have instructional potential. However, like any other technological innovations that always evolves, serious games design is just a beginning of a proper use of gaming technologies for education. Because of this, providing teaching and engineering methods for building serious games is required to provide both fun and effective learning experiences-pedagogy-driven serious games.





### **KEY DESIGN PRINCIPLES**



### Solve Education! uses the Learning Mechanics-Game Mechanics (LM-GM) framework (see Annetta and Bronack, 2011; Belloti et. al, 2011; Hirsh-Pasek, 2015; Kapp, 2012; Shapiro, 2014) for serious games to translate learning goals/practices into the mechanical element of gameplay, serving to an instructional purpose besides that of play and fun. Through the LM-GM framework, it is possible to evaluate the effectiveness of a given game and better understand how to implement it in educational settings. Taking this into consideration, developing a good core curriculum design is neces-

#### Figure 1: LM-GM Checklist

sary to identify and highlight the game's main pedagogical features, and link them with its entertainment elements. The curriculum is then checked and compared with the game mechanics using the LM-GM model checklist as illustrated below. The ultimate goal of doing this is to maximise the capability of the game app to engage and retain students in learning.

4 Bellotti, F., Ott, M., Arnab, S., Berta, R., de Freitas, S., Kiili, K., & De Gloria, A. (2011, October). Designing serious games for education: from pedagogical principles to game mechanisms. In Proceedings of the 5th European Conference on Games Based Learning. University of Athens, Greece (pp. 26-34).



### **KEY DESIGN PRINCIPLES**



Data-driven Approach to Increase Learning Motivation

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	— Solve Education! Approach	
Lots of Fur Scenttric tuices show that the least and	Los of Learning The positive for a positive for any of the positi	- Original States - Constraints - Constraint
Figure 2: Lea	rning Analytics Portal	's Landing Page

To optimise the potential of serious games design, Solve Education! uses data to enable students to become motivated and independent in the learning process (Annetta and Bronack, 2011). Through the use of the learning analytics<sup>5</sup> that is built as an extended platform for the game app, the team has invested in data collection and storage and development of context-sensitive algorithms which are all-important to improving teaching efficacy. Solve Education! is devoted to overcoming barriers that limit students access to education, and as such marginalise them from the economy, through a mobile phone gaming app. The team's focus is on finding ways to make learning compulsively engaging on a platform that allows it to reach those who need it most. The implementation of data-driven approach is hoped to cater to the needs of the individual students and provide them with evidence-based education. By collecting data on student learning behaviours and activities, the team is able to respond to students' needs and modify the game app according to what promotes the best learning. Solve Education! believes that educational data can improve the quality and value of the learning experience on the app.

5 Greller and Drachscler (2012) in their book 'Translating Learning into Numbers' provides a framework of how to design a tool (learning analytics) to help educators better improve the learning process, not just students but also other stakeholders within the education field.



# ARCHITECTURAL OVERVIEW



Solve Education! is experimenting with game mechanics, artificial intelligence, social media, and data to create an educational game app for its target beneficiaries. The app that is called Dawn of Civilization is an Android-based educational game app developed that is designed to provide young people, aged 15 onwards, with easy access to knowledge and skills. The app runs on low-end smartphones and intermittent internet (online/offline access) and is designed to engage students' hunger for learning and improve income prospects in a knowledge economy. Dawn of Civilization aims to engage and retain young people in a stimulating learning environment by creating an app that offers a sense of novelty and virality. Currently, the app is only available for Android smartphones since data shows us that most of our target beneficiaries are more likely to have or access Android devices than other portable devices.



### **ARCHITECTURAL OVERVIEW**



In 2017, Solve Education! launched the beta version of the game app with three English mini-games designed to teach vocabulary. The game app was created collaboratively with over 100 youth in Indonesia. The collaborators helped choose the name of the game, the first graphics and design of the app. Dawn of Civilization architecture is divided into two significant parts: a meta-game and an unlimited number of mini-games/bitesized lessons. The meta-game, the fun part, is designed to retain students so that they will continue learning. In the meta-game<sup>6</sup>, there is a city simulation game where students can create and manage a city as a mayor. They can construct a building, place landmarks in their town, or earn taxes from their citizens. To build things in the city, they need resources and reward cards, which can be obtained by playing the mini-games. The

mini-games are essentially the curriculum, designed to help students learn knowledge and skills in an engaging way.

**6** Unlike the common definition of the meta-game in the world of gaming. Meta-game in this context is defined as a part of the game in the platform designed to retain students and help them motivated to keep learning due to its engaging features.



# LEARNING AREAS

The learning areas taught in the core curriculum covers both literacy and numeracy. Literacy and numeracy are vital in preparing young people to thrive in the 21st-century knowledge economy; helping them within education and entering employment (see Burroughs and Smagorinsky, 2009; Christenbury and Smagorinsky, 2011; Frankenstein, 2001; Ginsburg et. al, 2006; Stacey, 2015; Stromquist, 2005). They lay the foundation of active participation in the society and lifelong learning. They are the key to help young people become self-flourished adults in the data-driven and interconnected world.

This chapter clarifies each learning area taught in the core curriculum. In each learning area, aims articulate the knowledge and skills each student is expected to accomplish, learning strands offers an overview of what is acquired during the learning process, and performance descriptors describe students' learning performance that is the result of the explicit learning instruction at the end of each learning interval.





## Language & Literacy

At first glance, literacy would seem to be a simple concept that everyone understands. In actuality, the concept of literacy and what it means to be literate is influenced by academic research, public policy, cultural context, and institutional agenda. Solve Education! defines literacy as the ability to acquire a language, construct meaning, and communicate thoughts and intention appropriately on a daily basis. The definition is aligned with the organisation's vision to help future generation access the knowledge economy. Through acquiring a language, and being able to exploit it in a proper manner, one can open the doors to unlimited opportunities. 'Literacy skills are fundamental to informed decision-making, personal empowerment, active and passive participation in local and global social community' (Stromquist, 2005, p. 12). If taught correctly, the empowering potential of literacy can translate into increased self-esteem, socio-political participation in society, and economic growth (UNESCO, 2006).

## The question is, *'what language should be taught first through the game app?'*

Solve Education! leverages pervasive access to broadband and Android smartphones to engage young people, especially the world's most marginalised, to learn the knowledge and skills they need to thrive in the 21st century knowledge economy. Today, there are many free online educational resources that can be accessed to learn advanced practical skills like coding, graphic design, data analysis, or even life skills.

However, those resources mostly use English as the language of instruction. That is why it is fairly difficult for young people especially from the emerging markets whose native language or second language is not English to compete with those who can speak English. Understanding that, it is clear that to strive and thrive in today's world, young people need to be literate in English. Acquiring the English language helps young people to be confident in their ability to communicate, creative and imaginative, and informed and engaged global citizens.

Having said that, Solve Education! does not deny the importance of mother tongues and that learning in one's mother tongue is one's right. However, due to the organisation's understanding that its beneficiaries live in different geographical locations and speak different languages, Solve Education! decided to go with English, first.

The English learning plays an important role in the development of overall literacy skills which support young people to become a thoughtful consumer of information through all media formats in today's globalised world. Through acquiring English, they can under-

### **LEARNING AREAS**



stand, analyse, communicate, or even challenge the information they get. English can also help them build and strengthen the relationship with people all around the world.

With that in mind, Solve Education! begins its literacy education by building a strong foundation of the English language for all of its students. English is both a learning area in its own right and the medium for teaching numeracy. Fluency in the English language is an essential foundation for success in the learning journey and job market.





# 01. Aims

The English curriculum aims to enable students to become functional in English and to ensure that students:

- Acquire a wide vocabulary;
- Listen with comprehension;
- Read easily, fluently and with good understanding;
- Use grammar and knowledge of linguistic conventions for reading, writing and spoken language;
- Write clearly, accurately and coherently;
- Speak articulately and appropriately.

## 02. Strands

#### Phoneme and Word Knowledge

Students' acquisition and command of the English sounds and vocabulary are key to their learning progress. Students should be enabled to differentiate sounds and recognise meanings in English and store those concepts in their long-term memory. They should also make links between known and new vocabulary and discuss the shades of meaning in similar words with others. Moreover, it is vital for students' comprehension that they understand the meanings of words in different contexts.

#### **Textual Communication**

Reading and writing skills are vital to support students' acquisition of knowledge and textual communication skills. Students should be taught to read fluently and be encouraged to read for pleasure. They should be taught the correct use of grammar so that they can read comprehensively and write coherently and cohesively. Reading comprehension is built through a combination of a word reading process and extensive reading. It means that students should start from understanding letters represent sounds in spoken words to comprehending meanings in long texts. Writing skills are built from quick spelling to composition. Effective composition involves forming, articulating and communicating ideas, and then organising them cohesively and coherently for (a) reader(s).



#### **Spoken Communication**

Students' spoken communication skills are vital for developing their vocabulary and grammatical competence as well as improving their reading and writing skills. They should learn to justify ideas with reasons; ask questions to check understanding; develop vocabulary and build knowledge; negotiate; evaluate and build on the ideas of others, and select the appropriate register for effective communication. They should be taught to give well-structured descriptions and explanations and develop their understanding through speculating, hypothesising and exploring ideas. Ensuring students' confidence and competence in listening and speaking is critical for their learning progress.

## 03.

## Performance Level Descriptors

Solve Education!'s English curriculum follows the Common European Framework of Reference (CEFR) to describe students' performance level. CEFR was published in 2001 by the Council of Europe to provide a common basis for the elaboration of language syllabus, curriculum guidelines, textbooks, and including tests across Europe. It has been translated into 40 languages and is now widely accepted as one of the most comprehensive and reliable sources of language teaching reference and used by educators around the world. The main aims of the CEFR are "to encourage reflection by users over the way their current practice meets the real world language needs of their learners and to provide a set of defined common reference levels (A1-C2) as points of reference to facilitate communication and comparisons" (Council B EAQUALS, 2010, p. 6) The classificatory scheme of the CEFR is useful to help

formulate and review curriculum objectives, content, testings, syllabus definition, material organisation, and even certification of proficiency that can be made specific to the local context.

The six reference levels of the CEFR has been adapted to Solve Education!'s teaching context by adding an opening level below A1 and omitting C2 levels. The first reason for doing that is because of many of Solve Education! target beneficiaries do not even have knowledge of the Latin script. The second is because Solve Education! understands its technological limitation to provide comprehensive teaching contents and assessment tools for C2 level. It is also important to note that students are considered to be ready to enter job market when they have reached B2 or C1 level.



The CEFR-based performance descriptors are provided as follows:

- Opening (Pre A): Students can demonstrate an understanding of basic communication using predictability and fundamental concepts of the English phonological processing system.
  - Breakthrough (A1): Students can understand familiar everyday words and expressions as well as very basic phrases with the purpose of satisfying concrete type needs. They can introduce him/herself and others as well as answer and ask personal questions such as where he/she lives, people he/she knows and things he/she possess. They can interact in a simple manner given the other person talks slowly and clearly and is willing to help.
  - Waystage (A2): Students can understand complete sentences and frequently used expressions (e.g. personal and family information, shopping, local geography, employment). They can exchange simple and direct information to communicate familiar and routine matters. They can describe aspects of his/her background, surroundings and issues in areas of immediate basic needs in simple terms.
- Threshold (B1): Students can understand the main points of clear, standard input on familiar matters encountered in everyday situations such as work, school and leisure activities. They can deal with most circumstances that arise when travelling in an area where the language is spoken. They can produce simple and coherent texts based on topics which are familiar or of personal interest. They can describe personal experiences, events, dreams, hopes and ambitions as well as briefly give reasons and explanations for their opinions and plans.
- Vantage (B2): Students can understand the main points of complex texts or speech arising from both concrete and abstract concepts, including technical discussions in his/her field of specialisation. They can interact fluidly with native speakers with a degree of fluency and spontaneity. They can produce clear and detailed texts while capable of evaluating and explaining their viewpoints on various issues.
- Effective Operational Proficiency (C1): They can understand a broad range of demanding, longer texts, including the ability to draw out implicit or nuanced meanings. They can possess the ability to express him/herself fluently, spontaneously and use the language flexibly in a social, academic and professional context. They can produce clear, well structured and detailed text on complex subjects as well as showing clear evidence of control in use of organisational patterns, connectors and cohesive devices.



The term numeracy, initially characterised as a reflection of literacy, was first introduced in 1959 in the UK Crowther Report (Rogers, 1980). Since then the definition of numeracy and what it means to be numerate have been contested. Solve Education! defines numeracy (Mathematical literacy) as the ability and confidence to engage with numbers and data to make mindful and reasonable decisions on a daily basis. A numerate student has the awareness and confidence to know when and how to apply quantitative and spatial understandings in real everyday situations. It is utmost important to equip students with quantitative understandings because it can help students to develop a sense of the magnitude of numbers, use numbers in real-life situations. estimate amounts. interpret statistical information, recognise patterns, and determine probability. Teaching spatial information is also critical in helping students to become aware of and visualise shape and space from different perspectives, measure time, weight, height, or amounts, determine location and direction, and interpret and create maps and schematic diagram. The goals are really helping students be more competent and confident to use numbers and data in both daily life and workplace. Poor numeracy in young people can affect their level of confidence and self-esteem. Those who are not numerate will struggle to in every aspect of their lives be it at home, school, or work. People

solve

need to use maths when they go grocery shopping, commute to work, decorate a room, or decide whether to buy discounted items or not. Most of the decisions in life are based on numerical and spatial information, and to become a good decision maker people need to be numerate.

Living in a knowledge-based economy like today, people both young and old are presented with (un)limited access to numerical data that can sometimes be quite overwhelming to take. Although, we know that computers can do most things a human can do, or even do a better job at doing mathematical processing, people need to be numerate to be able to distinguish data and interpret them correctly. Solve Education!'s mission is to prepare young people for the workforce of today and the future, and to be prepared for that means to be numerate. When young people fall behind in numeracy early on, that will make them fall behind other learning areas necessary for job market because the failure is usually compounded over the years. That is why Solve Education! puts a high value on numeracy.



# 01. Aims

The numeracy curriculum aims to enable students to have the conceptual understanding and procedural knowledge to use numbers and think mathematically on a daily basis and ensure that students:

- Eliminate the "I can't do Math" mindset;
- Gain confidence and perseverance in solving basic mathematical problem(s);
- Able to use the mathematical knowledge and skills to meet the varied demands in personal and professional settings;
- Practice the capacity of adaptive reasoning which include local thought, reflection, explanation, and justification.

# 02. Strands

#### Contextual and Situational Understanding

Many young people or even adults are unaware that most of our day to day activities involve numeracy. This problem is perpetuated by the current education system which emphasises on the teaching activity (textbook oriented learning) rather than learning activity (linking numerical problems with students' daily life) (Sutama and Narimo, 2013). Students should be taught to recognise that "mathematical ideas are embedded within meaningful contexts and may be represented in a range way or example, by objects and pictures numbers and symbols, formulas, diagrams and maps, graphs and tables, and texts" (National Centre of Literacy and Numeracy for Adults, 2013, p34-35).

Using representational models, strategies, and familiar problem-solving contexts in numeracy learning processes will help students enhance their critical thinking and decision making skills. When students can bring the contexts to the learning process and bring what they have learnt to solve real situational problems, it should be a "proving" ground for their improved skills.

#### Conceptual and Procedural Knowledge

According to a study conducted by Rittle-Johnson et al. (2001), competence in math requires knowledge of both conceptual and procedural knowledge. Conceptual and procedural knowledge does not develop in an all-or-none fashion, with the acquisition of one type of knowledge preceding the other.



Both conceptual and procedural knowledge develop in gradual, back-and-forth process. So neither type of knowledge is fully developed at the beginning or the end of the study. Studying just one type of knowledge in isolation may lead to an incomplete picture of knowledge and may obscure important change processes. Therefore, students should be taught in a way that can help them go back and forth between understanding abstract conceptual knowledge and concrete procedural knowledge.

## Adaptive reasoning and problem-solving skills

The ability to apply diverse strategies to manage quantitative situational problems is required throughout one's life. Although some strategies are acquired through non-formal learning (through experience and self-invented methods), good problem-solving skills are usually derived from the ability to re-construct reality in a mathematical way (modelling or mathematising) which is usually gained from good learning instructions. To do that, students need to be equipped with adaptive reasoning skill. According to Kilpatrick et al. (2001, p. 129), adaptive reasoning can be defined as "the capacity to think logically about the relationships among concepts and situations". Therefore, students need to be taught to recognise logical connections between each element in situations and make generalisations about their relationship. Once they see the connections, they need to be taught to choose a particular solution method and with a justification that will help them solve the problem in a reasonable manner. For example, it is vital for students to have very strong arithmetic skills because by learning arithmetic they can recognise recurring patterns and complete analogies.

#### **Precision and Accuracy**

In order to choose the best approach to solving a situational problem, students should begin by making a decision that is precise and accurate. Precision in mathematics is defined as how close the different measured values are to each other. Accuracy in mathematics is defined as how close a measured value is to the actual value. Take for example in football, when a player always hits the right goal post instead of scoring, then he/she is precise but not accurate. It is important to teach students to focus on getting the truth (answer) to a mathematical problem to avoid 'false precision'. To practise the skills of precision and accuracy, students should be taught to ask very specific questions to guide them solve the problem. As illustrated by the National Centre of Literacy and Numeracy for Adults (2013, p. 36), the guestions can include, 'How accurate do I need to be?', 'What tools (such as a calculator, a measuring tape, or pen and paper) should I use?', 'What units do I need to use?'.

#### **Beliefs & Attitudes**

Positive beliefs and attitudes are the first steps to success in math. However, most of the time math teachers encounter students who are not confident and afraid of learning math. According to Judy Willis (2010), some of the factors that cause negative beliefs and

### **LEARNING AREAS**



attitudes towards mathematics include past failures in learning math that result in low self-expectations, parental bias against math, feeling inadequate to succeed at math learning, failure to engage math through learning strengths, and fear of making mistakes. These beliefs and attitudes if not addressed can promote stress, decrease learning motivation and levels of participation, boredom, low tolerance for the challenge, failure to keep pace with the lessons, behaviour problems, and avoidance of continual learning which is necessary for subsequent professional success. Therefore, it is utmost important to change these negative beliefs and attitudes so that students can get the maximum benefits of learning math. There are many ways to form students to turn the negativity into positivity. First, students need to be taught why it is important for them to learn math. The explanation should be contextual and practical so that students can easily relate to it. Second, before students become interested in the learning, they must feel comfortable with it. Ensuring a safe environment for learning is necessary to build students' motivation, resilience, and coping strategies when they learn. Lastly, developing a strong foundational knowledge is vital to help students achieve mastery in each topic. When students are allowed to re-learn and re-test each math concept, they will develop their self-reliance and independent learning attitude. Once the door to negative beliefs and attitudes is closed, students can start seeing math as an accessible and valuable tool for them to understand the world they live in and solve problems in it.





# **03.** Performance Level Descriptors

Solve Education!'s Numeracy curriculum follows the OECD's Programme for International Assessment of Adult Competencies (PIAAC). PIAAC covers pedagogical design and framework that are suitable to measure individual's ability to use, apply, interpret, and communicate mathematical information and ideas. PIAAC emphasises on measuring the critical skills need to be possessed by individuals to survive in a world where quantitative and mathematical information is inevitable.

The PIAAC-based performance descriptors are provided as follows:

### PRE LEVEL 1

Students can carry out simple processes such as counting, sorting, perform basic arithmetic operations with whole numbers or money, or recognise common spatial representations.

### LEVEL 1

Students can carry out fundamental mathematical processes in familiar, concrete contexts where the mathematical content is explicit. Tasks usually require one-step or simple methods involving counting; sorting; performing basic arithmetic operations, and identifying elements of simple or common graphical or spatial representations.

### LEVEL 3

Students can apply number sense and spatial sense; recognising and working with mathematical relationships, patterns, and proportions expressed in verbal or numerical form; and interpreting data and statistics in texts, tables and graphs.

### LEVEL 5

Students can integrate multiple types of mathematical information where considerable translation or interpretation is required; draw inferences; develop or work with mathematical arguments or models, and critically reflect on solutions or choices.

### LEVEL 2

Students can apply two or more steps or processes involving calculation with whole numbers and common decimals, percentages and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics in texts, tables and graphs.

### LEVEL 4

Students can do analysis and more complex reasoning about quantities and data; statistics and chance; spatial relationships; and change, proportions and formulas. They may also require understanding arguments or be communicating well-reasoned explanations for answers or choices.



# ASSESSMENT & EVALUATION

Solve Education!'s approach to assessment and evaluation always begins with its educational values. It reflects an understanding that every student progresses according to their own pace and alignment with the learning objectives that were set in the curriculum. The assessment and evaluation methods aim to measure learning outcomes and at the same time use the data and information collected to enhance students' development progress and accomplishments. The assessment should enable students to strengthen their learning motivation and enable them to recognise their highest potential to achieve success in learning.

Since the curriculum is delivered through many units (mini-games) in which each unit contains several different lessons, Solve Education! assesses and evaluates the learning processes and progress through formative and summative assessment. The formative assessment is in forms of diagnostic testings that are specifically designed for each learning area, and summative assessment in forms of bonus games that are presented after they complete each learning mission (learning level). First, the concept of diagnostic testings in education is borrowed from the medical field to identify a disease through patient's symptoms. It allows the doctor to assess the potential threat that can jeopardise the patient's life and give the right treatment to tackle that. In this context, diagnostic testing is used, prior to instruction, to assess individual students' strengths, knowledge, and skills that they have. Establishing these permits Solve Education! to feed the right contents (adjust the curriculum) to each student, and meet each his/her needs. Second, bonus games allow students to see if they have made progress in learning. The results of the bonus games can give students an overview of how well they are performing and determine if they can unlock other mini-games to continue learning.





## **Question Recycling System**

In order to enhance the learning processes in the app, Solve Education! has developed a Question Recycling System based on the Spaced Repetition Model<sup>7</sup>. This model is often used in the traditional model of teaching/learning which implements increasing intervals of time between subsequent review of a previously learned concept in order to exploit the psychological spacing effect. In this context, this model is applied to the app so that students can be fed the right content in the right timing for effective learning.

7 Space Repetition Model is a technique for effective memorisation and practice of skills. Each concept or skill is presented periodically using increasing intervals of time to allow the concept and skill stored in student's long-term memory. Ausubel, D. P., & Youssef, M. (1965). The effect of spaced repetition on meaningful retention. The Journal of General Psychology, 73(1), 147-150.





The Spaced Repetition Model is crucial in enhancing the brain's capacity to move each learnt concept from Short Term Memory to Mid Term Memory, and then to Long Term Memory that is utmost important in learning. The Question Recycling System is used to support both formative and summative assessment in the app and can work on various learning concepts in both literacy and numeracy (see Ausubel and Youssef, 1965; Settles and Meeder, 2016). It works through the use of an algorithm which monitors students' retention accuracy and prompts students to answer questions just as they are about to forget the particular learning concepts. More importantly, the Question Recycling System is implemented to better support students learning offline. It is applied on the client's side (on the student's phone) with the server supporting the accuracy of the system.

## Learning Analytics Portal

Investment in data collection and storage and development of context-sensitive algorithms are all-important to improving teaching efficacy. Solve Education! is devoted to overcoming barriers that limit student access to education and focus its energy to find ways to make learning compulsively engaging on a platform that allows it to reach those who need it most. As a human-centred technology, Solve Education! ensures that we cater to the needs of our individual students and provide them with evidence-based education. By collecting data on student learning behaviours and activities, we are able to respond to their needs and modify the game app according to what promotes the best learning. We believe that educational data can improve the quality and value of the learning experience on the app.





Four key metrics are used in the Learning Analytics Portal as part of the curriculum evaluation process are explained below:

- The Popularity of Minigames: We evaluate learning intensity of each individual student (how engaged are users with the mini games in the app?) and the length of study (how long do users play these minigames, in minutes?) to compare the popularity of mini games among users.
  - Periodical Learning Intensity: We detect students' passive behaviour or inactivity indicating that they are not interested in learning/playing. After receiving and analysing the information, we can respond by notifying students (users) on their phone, or sending emails to invite them to continue playing the game.
  - Student Success Scorecard: We show each individual student's learning progress using a periodical line chart.
  - Learning behaviour. This metric is used to illustrate students' soft skills i.e. grit, diligence, and discipline.
  - Activity Tracking System: We track students who quit the game more than 30 days of playing.





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SE	Pre A.2	Speaking: Pronounce English Reply with a one-word answer. VMriting: Able words and English names.				Pre A.2
Objective	Pre A.1	Demonstrate an an inderstanding of basic communica- communica- comusing redictability and concepts of the concepts of the concepts of the concepts of the concepts of the concepts of the concesting system. and an entry phonological biotemic and an entry sing contents and wareness wareness wareness wareness hole of code code code code code code code code	alphabet. Ability to ecognise and understand most igh-frequency	vords, basic numerical concepts.	Topics	eople's Names





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C1.1	Novels Editorials Mass media Electronic literature	C1.1	Conceding a point Critiquing and reviewing constructively Defending a point of view persuasively Emphasizing a point, feeling, issue Expressing feelings precisely Expressing reaction, e.g. indifference Expressing shades of opinion and certainty		C1.1	Futures (revisi Inversion with adverbials Mixed conditic present and future Modals in the Modals in the Warative tensi experience, incl. passive Passive forms phitting wish/if only re
B2.3	Editorials Mass media Electronic literature	B2.3	Developing an argument Expressing abstract ideas Expressing agreement disagreement disagreement disagreement informally, expressing informally, expressing informally, expressing interest, sympathy, surprise etc. Opinion, justification Synthesizing, evaluating, glossing info		B2.3	have sulation
B2.2	Editorials Mass media Electronic literature	B2.2	Describing feelings and emotions Encouraging and inviting another speaker to comtine, come in Expressing reaction, e.g. indifference Speculating		B2.2	d adverbs uous t continuous onals thave, needn't luction and spec es ontinuous , extended es
B2.1	Novels Editorials Mass media Electronic literature	B2.1	Describing experiences experiences Describing hopes and plans Critiquing and reviewing Taking the initiative in interaction		B2.1	Adjectives an Future perfect Future perfect Future perfect Mixed condition Modals – can Modals of dec Narrative tens Passives Past perfect Past perfect Phrasal verbs Reharive claus
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B1.1	Social and formal Context/news- paper articles Editorials	B1.1	Demonstrating comprehen- sion Narrating experiences and events and events and events emotions emotions		B1.1	Adverbs Broader range as too, enough Comparatives Complex ques Conditionals. 2 Conditionals. 2 Conditionals. 7 Modals - must Modals - must Modals - shou Modals - shou
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A2.2	Social and formal Context/news- paper articles	A2.2	De scribing things Recounting past experiences Composing Formal Requests Stating Suggestions Analysing obligation and necessity		A2.2	omparative, – u tie article uperlative – use ses of time, plac – including wor tenercy artency ouns d Uncountables d Uncountables d ill and going to)
A2.1	Social and formal Context/edito- rial articles	A2.1	Describing habits and routines Recalling past experiences people Describing places		A2.1	Adjectives – c than and defin definite article Adverbial phrae Adverbs of fre- Adverbs of fre- Articles – with Uncountable an much/many Future Time (v Goind fo
A1.3	Advertise- ments Recipe Memos Shopping list	A1.3	Understanding and using numbers Quote using prices bescribing habits and routines		A1.3	s
A1.2	Social context Itinerary	A1.2	Giving and receiving directions Trelling the time State habits and routines Scheduling days, weeks and months		A1.2	mmon and demi- quency and superlative: <i>n</i> many and ven untable nouns '-)
Jenre A1.1	Social context Information text Phone directory Questionnaires	LIA	Greetings Provide information Listing habits and routines		A1.1	Adjectives: col Adverbs of fret Comparatives Going to How much/hol common unco I'd like I'f like I'f nike I'f nike
materials/		IS Pre A.2	0, 100, 1000	-	Pre A.2	
Focuseu Pre A.1	Social Context	Function Pre A.1	Greetings Spelling Counting 0 to 1	Gramma	Pre A.1	

		C1.2	s, logical cture and rmal speech		C1.2	(vague uage se friends s, different ormal sssions	
		C1.1	Linking devices markers Markers to stru signpost formal and info and writing		C1.1	Approximating language) Collocation Differentiated t vocabulary fail elliminating fail (similar sounds meanings) Formal and inf registers Idiomatic expression	
		B2.3	e espite e		B2.3		
		B2.2	rds expressing trast etc. kers to structur gh, in spite of, d ntial – past time		B2.2	ag de	
		B2.1	Connecting we and effect, com Discourse mar formal speech Linkers: althou Linkers: seque subsequently		B2.1	Collocation Colloquial lang	
(see		B1.3	cause and		B1.3		
onses extended continuous /past simple ch (range of ten in the past i.o. for prediction		B1.2	etc etc trial past time		B1.2	uage wm, shops and ices	
Past tense response Phrasal verbs, ever the contract of the contract Present perfect. Present perfect. Rimple passive Mh- questions in Mill and going to Mill and going to		B1.1	Connecting wo effect, contrast Linkers: sequer		B1.1	Collocation Collocation shopping Travel and serv Travel and serv	
ë		A2.3			A2.3	tion, shoppin d	
to id common - common use of 's, s, inases (place, it, time: on/in/at tous ous for future i use ilke/ i past inditional		A2.2	titial - past time		A2.2	sonality, descrip wn, shoops and d	
Modals – have Modals – shoul Past continuou Past simple Past simple Prassives – Prepositional pl and movement Present continu Present continu Present continu Present continu Present continu Present continu Present perfect Verb + ing/infin want-would like Wh-questions in Wh-questions in		A2.1	Linkers: sequen		A2.1	Adjectives: pers feelings Food and drink Body parts Jobs Animals Transportations Furniture Travel and serv	
j in/on/at atives		A1.3	ecarse		A1.3	sbe shopping	
jjectives common f place f fime, includin nous includin ple, personal g question+neg g question+neg		A1.2	ords, and, but, b		A1.2	own, shops and	
Past Simple Possessive at Possessive s Prepositions ( Prepositions c Present simpli Present simpli Present simpli Pronouns: sim Questions There is/are To be, includin Verb + ing: like		A1.1	Connecting w		A1.1	Colours Food and drin Animals Jobs Clothes Body Parts Personal infor Things in the 1 Verbs - basic	
	e Markers	Pre A.2		ary	Pre A.2		
	Discours	Pre A.1		Vocabula	Pre A.1	Alphabets Numbers English Names Greeting Verbs	



#### Capable of integrating multiple types mathematical arguments or models, and critically reflect on solutions or of mathematical information where Level 5.2 inferences; develop or work with interpretation is required; draw considerable translation or Level 5 Level 5.1 choices. proportions and formulas. They may Capable of doing analysis and more complex reasoning about quantities Level 4.2 spatial relationships; and change, arguments or be communicating and data; statistics and chance; well-reasoned explanations for also require understanding Level 4 answers or choices. Level 4.1 **Teaching Inventory for Numeracy Programme** numerical form; and interpreting data Capable of applying number sense and spatial sense; recognising and proportions expressed in verbal or Level 3.2 and statistics in texts, tables and working with mathematical relationships, patterns, and Level 3 Level 3.1 graphs. rounding numbers positive and negative numbers less than 1000 to given formulae in words and and interpretation of relatively simple Read, write, order the nearest 10 or 100. practical context. expressions and symbols to produce results. calculation with whole numbers and common decimals, percentages and Approximate by substitutions in fractions; simple measurement and of any size in a Calculate ratio spatial representation; estimation; Level 2.2 data and statistics in texts, tables and compare Capable of applying two or more proportion. and direct Evaluate steps or processes involving make Level 2 Recognise the usage of negative Estimate answers numerical relationships (e.g. Recognise, order, multiply, and divide efficiently written methods. Work out simple ratio and direct proportion. Use a calculator including large to calculations. using accepted using integers. numbers in everyday life. Add, subtract, multiples and Level 2.1 and compare calculations and graphs. Recognise numbers, numbers. squares). to check whole numbers by Multiply two-digit whole numbers by size using efficient methods. single-digit whole Approximate by rounding to the single-digit whole Add and subtract connections with connections with calculations with numbers of any Capable of carrying out fundamental using three-digit whole numbers. operations, and identifying elements divide whole numbers by 10 sorting; performing basic arithmetic Divide two-digit facts up to 10 and 100 and facts up to 10 and 100 and mathematical processes in familiar, simple methods involving counting; Level 1.2 division facts. multiplication division facts. multiplication of simple or common graphical or numbers and Multiply and Tasks usually require one-step or mathematical content is explicit. remainders. nearest 10. Carry out numbers. interpret and 100. concrete contexts where the Recall Recall make make spatial representations. Level 1 obelus (÷), and equals sign (=) in practical visualise, and use the plus sign (+), single-digit whole Add and subtract solving problems. Add and subtract using three-digit whole numbers Count reliably up and subtraction two-digit whole Recall addition numbers up to numbers up to Multiply using minus sign (-), write, arrange times sign (×), situations for Level 1.1 arrange and compare and compare to 20 items. Read, write, Count, read, facts to 20. written or numbers. numbers mentally. Interpret, mentally. 1000. 100. sign (-), and equals sign (=) in practical situations for solving problems. visualise the plus Recall addition and subtraction facts to 10. Add single-digit numbers to a sum of 10. Use a calculator processes such as counting, sorting, Pre Level 1.2 Subtract single-digit numbers from sign (+), minus numbers up to to check calculations using whole operations with whole numbers or nterpret and money, or recognising common Capable of carrying out simple numbers. performing basic arithmetic Pre Level 1 0. spatial representations. **Number Sense** Count reliably up Recognise the numbers on the Pre Level 1.1 numbers up to 10, including Read and write numbers up to 10, including zero. given text (all vords in the to 10 items. alphabet). Order and compare zero.



Level 5.2			Level 5.2	olve problems wolving 2D hapes, essellation, essellation, aratel lines (e.g. i laying down arpet tiles).
Level 5.1			Level 5.1	Solve problems S using angles in ir relation to it strates, p p topography. ir ir ir ir
Level 4.2	Demonstrate the likelihood of an event using fractions, decimals, and percentages with the probability scale of 0 to 1.		Level 4.2	Apply given formulae for finding areas of composite shapes (e.g. non rectangular rooms or plots of land). Comprehend and apply given finding volumes of regular 3D shapes.
Level 4.1	Demonstrate that some events are more likely to occur than others.		Level 4.1	Recognise and use common 2D representations of and objects (e.g. in maps and plans). Identify at least 5 regular three-dimensional shapes. Draw and state the properties of prependicular lines and parallel lines.
Level 3.2	Add, subtract, multiply and divide decimals up to three places. Order and compare order and epercentages and percentages and percentage and decrease. Find percentage and measure- ments. Evaluate one number as a percentage of another. Use a calculator to calculate efficiently using whole numbers, decimals and percentages.		Level 3.2	Work out the perimeter of simple geometrical shapes. Determine the area of rectangles and circles. Estimation and measurement of angles in unknown degrees.
Level 3.1	Identify equivalences between fractions, decimals and percentages. Evaluate one number as a fraction of another. Use fractions to add and subtract amounts or quantities. Order, order, amother and order and subtract amounts or quantities.		Level 3.1	
Level 2.2	Identify simple Identify simple aspects of quantifies and measurements. Find simple percentage increase and decrease and decrease and compare decimals up to three decimal places. Mad, subtract, multiply, and divide decimals up to two places. Use fractions to order and compare amounts or quantities.		Level 2.2	Name and describe the properties of common 2D shapes. Use positional vocabulary. Create geometric create geometric create geometric trans tessellation. Name and relate extension of turns, 360°. 360°.
Level 2.1	Convert a fraction to a percentage. Convert decimal into a simplest fraction form. Read, write, order and compare simple e simple for and compare simple increase and decrease.		Level 2.1	
Level 1.2	Recognise, order, and compare common fractions and mixed numbers. Identify among between, fractions, among between, fractions, among between, fractions, common fractions, and use decimals and use these to find part of whole-number quantities. Multiply and divide decimals by vounding to a whole number or two decimals to vounding to a whole number or two decimals to solve problems in context, and to check calculations.		Level 1.2	Name and describe the properties of common 2D shapes. Identify shapes that can tessellate. Differentiate everyday positional voccabulary (e.g. beceabulary (e.g. beceabulary (e.g.
Level 1.1	Read, find, write and compare halves and quantities. Read, write and understand common fractions (e.g. 3 /4, 2/3). Identify aspects of whole number quantities or reasurements (e.g. 1/4 or 2/3) Recognise and understand use equivalent forms (e.g. 5/10 1/2). Read, write and understand decimal place, s(und a common measures to one decimal place, s(und a common motation, e.g. \$2.25).		Level 1.1	
Pre Level 1.2		ace	Pre Level 1.2	Recognise and name of common 20 shapes. Classify and count each shape from the given image.
Pre Level 1.1		Shape and Spa	Pre Level 1.1	



Level 5.2	
Level 5.1	
Level 4.2	
Level 4.1	
Level 3.2	Calculate with units of measure within the same system. Calculate with using conversion tables and scales, ables and scales, conversion factors.
Level 3.1	Calculate using time. Calculate, measure, and record time in different formats. Calculate with autosof money autoson currencies.
Level 2.2	Read, approximate, messure, and emeasure, and weight, capacity and temperature using common using common using common instruments. Read, estimate, measure, and compare length compare length using trandard units. Read, estimate, monstandard and standard units. Estimate, monstandard and standard units. Estimate, measure, and compare length using metric and, using metric and, where appropriate, imperial units. Estimate, measure, and compare length using metric and, where appropriate, including reading scales and conversion tables.
Level 2.1	Add and subtract sums of money using decimal notation. Read and interpret distance in everyday situations. Choose and use appropriate units and measure instruments. Read, measure, and record time in compare length and standard and standard
Level 1.2	Understand, approximate, measure, and compare standard and non-standard and non-standard and non-standard units (e.g. metre, centimetre, paces). Read, estimate, measure and compare capacity using common standard units (e.g. kilogram). Read, estimate, measure and compare capacity using common standard and compare capacity situations such as weather charts. Read and compare positive errest shallest denominator of the nearest shallest denominator of the calculations. Read, measure and make approximate calculations. Read, measure and record time.
Level 1.1	Make amounts of money up to \$1 in different ways cents, 5 cents, 10 cents, 5 cents, 10 cents, 5 cents, 10 cents, 20 cents and 50 cent coins. Counting amount of more within multiples of in line with local currency for thousands (in line with local currency for thousands (in line with local currency for evample, Indonesian Rupiah, India Rupiah, India Raad and tecord dime to common date formats. Read and record dime in common date formats. Add and subtract common units of measure within the same system. Calculate with within the same system.
Pre Level 1.2	Apply direct comparisons for the size of at least two items. Describe length, width and height of items. Describe weight comparisons for the weight of items. Describe capacity of items.
Pre Level 1.1	Recognise and notes. Recognise the spatial representation with subsidiary measurement (e, how many sick needed to reach a desl). Relate familiar events to: times of the day; days of the week; year.



	Level 5.2	Analyse the data given on table, find the relation between two variable of two variable of two variable of two variable of two variable of two variable actornate the data no find the data no find the action (e.g currency rate Joan and interests).		Level 5.2	Analyze the given problem of some hidden set harmonic sequence. And conclude the right statement for the situation.
- 	Level 5.1	Analyse the data from a complex graph or chart and choose the right choose the right course of an action to do. Analyse the given with the graph, with the graph, with the graph, and choose the most profitable solution (e.g solution (e.g solution the and investment).		Level 5.1	Analyze the relation and the hidden on a given real life situation problem.
	Level 4.2	Find the range of data from a mean of Extract data from a graphic and calculate the right answer for some situational problem (e.g. proplem (e.g. proving tax on previous year rates).		Level 4.2	Identify the relation between in 2 variable in an proportion problem .
	Level 4.1	Obtain discrete and continuous data from tables, diagrams, charts and line graphs. Collect, organise and represent discrete and continuous data in tables, charts, diagrams and line graphs.		Level 4.1	Identify the rule of a complex arithmetic arequence. Find the rule of a sequence. Find the relation between 2 geometric progressions.
	Level 3.2	Observe and record information using a tally. Organise and represent information in different ways so that it makes sense to others.		Level 3.2	Find the missing number in a set of antihmetic fraction sequence. Find the formulae of a sequence. Find the pattern of a simple age comparison between A and B in N years). Express ratio in form. Work out form scale drawings (e.g.
	Level 3.1	Generate numerical comparisons from bar charts and pictograms. Interpret the given graph, chart or table and give a right information of it. information of a grouped data from the text and calculate the mean or median of the data.		Level 3.1	Find the relation on a set of simple pattern, simple pattern, and estimate the missing or next incoming pattern. Find the missing withol in a set of simple arithmetic sequence. Identify the relation between 2 sets of sets of sets of set of
	Level 2.2	Communicate information so that it makes sense to others (e.g. in lists, e.g. in lists, e.g. in lists, diagrams). Construct simple representations or diagrams, knowledge of numbers, knowledge of numbers, knowledge of numbers, find the range for a set of data.		Level 2.2	
	Level 2.1	Get accurate information from lists, trables, simple diagrams and block graphs. Sort and classify objects understanding intersections. Extract intersections. Extract information from lists, tables, diagrams and simple charts.		Level 2.1	
-	Level 1.2	Make numerical comparisons from block graphs. Collect simple numerical information. Find the arithmetical average (mean) for a set of data. Calculate the mean of a simple grouped data. Find the median of a simple		Level 1.2	
	Level 1.1	Extract simple information from lists. Interprets data uusing ordinal uusing ordinal uusing ordinal uusing ordinal uusing arding a single criterion. Understand the intersections. Understand the mean and mode from a simple grouped data.	nge	Level 1.1	
stical Measures	Pre Level 1.2		onship, and Cha	Pre Level 1.2	
Data and Stat	Pre Level 1.1		Pattern, Relati	Pre Level 1.1	

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