THE INTRICATE RELATIONSHIP BETWEEN INTELLIGENCE AND ACADEMIC ACHIEVEMENT: EXAMINING THE ROLE OF STUDENT'S SELF-REGULATED LEARNING STRATEGIES

By

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Under the Guidance of

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The thesis is revised as per the modifications and recommendations reported by the adjudicators and resubmitted. Soft copy attached is the same as that of the resubmitted revised copy.

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DECLARATION

I, Shamla.V.M, do hereby declare that this thesis, **"THE INTRICATE RELATIONSHIP BETWEEN INTELLIGENCE AND ACADEMIC ACHIEVEMENT: EXAMINING THE ROLE OF STUDENT'S SELF REGULATED LEARNING STRATEGIES"** is a bona fide record of the research work done by me under the guidance of **Dr. C. JAYAN,** Professor and Head (Retd.), Department of Psychology, University of Calicut. I also declare that this thesis has not been submitted by me for any award of a degree, diploma, associateship, fellowship or other similar title of recognition.

Place: Calicut University

Date: **SHAMLA.V.M**

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Shamla.V.M

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ABBREVIATIONS

AA	:	Academic achievement
FSIQ	:	Full scale IQ (total score obtained from MISIC)
IQ	:	Intelligence quotient (Intelligence)
VIQ	:	Verbal IQ
PIQ	:	Performance IQ
MISIC	:	Malin’s Intelligence Scale for Indian Children
SRLS	:	Self-Regulated Learning Strategy
BEH	:	Behaviour regulation
COG	:	Cognitive regulation,
EM	:	Emotion regulation.
META	:	Metacognitive regulation
MOT	:	Motivation regulations

PUBLICATIONS

(Copy of publications are attached as appendix H)

Shamla, V. M., & Jayan, C. (2018). Analysis of Theories of Intelligence: Emerging Themes. *International Journal of Creative Research Thoughts*, *6*(2).

Shamla, V. M., & Jayan, C. (2018). Present Status of Intelligence Testing: A Critical Analysis of WAIS, WAPIS, And MISIC. *Zenith International Journal of Multidisciplinary Research*, *8*(8).

Shamla, V. M. (2017). Revitalizing Intellectual Assessment of Kerala. In C. Jayan (Ed.), *Current Trends in the management of Developmental disabilities* (1st ed.). essay, CDMRP, University of Calicut.

Chapter 1
Introduction

- **Self-Regulated Learning**
- **Intelligence, Academic Achievement and Self -Regulated Learning Strategies.**
- **Literature Review**
- **Need and Significance of the Study**
- **Statement of the Problem**
- **Definition of the Key Words**
- **Research Questions**
- **Objectives**
- **Hypotheses of the Study**
- **Research processes**

“How could one, most ingeniously improve a student’s ability to competently execute academic skills and achieve academic learning?”

Education is the back bone of every society. Through proper education, societies achieve social, economic, technical and cultural development. Educational institutions mould students to develop their potential and also work towards the goal of student’s use of their potential for development of society as they are the future citizen. Evolution in education has made learning an important and essential developmental task, from pre-school to professional courses. Thus, learning and knowledge acquisition has become essential in human life. From time to time various teaching-learning methodologies flourished. During the last years- a shift from teacher centred approach in learning to learner centred approach occurred. Thus, through this approach researches started focusing on responsibility of learner to become an independent learner.

At present education plays a vital role in one’s life, and has become one of the challenging phases all over the world. Its importance and concern have increased manifold. In Indian culture, especially – in a socio economic and cultural context of Kerala, academic achievement is given profound importance. High scores/ higher grades are valued highly by parents, teachers and students. Getting admitted to next preferred higher study is also been increasingly linked to scores obtained on the final mark sheet. So, obviously schools give great emphasis on achievement from pre-school to formal education. In school, more emphasis is given for systematic activities for increasing academic achievement of individual student and for school as a whole. Opportunities for advanced higher studies are opened up mainly based

on scholastic attainment. Even though sports, arts, cultural activities, music and other extracurricular activities and competitions find their own place in education, ultimately in the end, focus is on the grade card or mark sheet. Parents, teachers and students focus more mainly on student's achievement in school rather than on student's ability to learn. Even though it is agreeable among teachers that there is individual difference in learning potential and achievement, they force students for traditional 'memory' focused learning for scoring high grade. In this scenario the question stated in the beginning becomes highly relevant and significant.

Learning in an educational setting can be influenced by a myriad of factors. Factors can be personal or socio- contextual factors (Lee & Shute,2010). Personal factors can be - intelligence (Noeryanti, et al., 2018), health (Bhowal et al., 2015) motivation, self-efficacy (Turner et al., 2009), self-concept (Dulay, 2017), locus of control (Çoğaltay, 2017), personality traits (Malyhk, 2017), emotional intelligence (Laidra et al., 2007) learning strategies and school engagement (Lee & Shute, 2010) etc. Socio – Contextual factors can be school environment (Wang & Holcombe, 2010), parental involvement (Jeynes, 2005), parenting style (Turner et al., 2009) and socio-economic status (Guvan,2019), etc., Limiting to the scope of present study, more focus was given to personal factors. Thus, intelligence was decided as a separate variable, while most of the other personal variables such as motivation, self-efficacy, planning, emotion regulation, time management, test anxiety, etc., were conceptualised as learning strategy variable. More importance was given to successful regulation of personal variable specific to learning situation, frequently known as self-regulated learning.

Self -Regulated Learning

Research works about the factors which predict academic achievement are so abundant that a single formula can't be developed. However, most of the personal factors such as academic motivation, self-esteem, study habits, test anxiety, help seeking habit, cognitive ability, time management ability, planning and academic goals, etc., can be conceptualised in a way of regulation of self for learning. These factors can be brought together as a multi -dimensional model under an umbrella term known as self-regulated learning. Recently self-regulated learning has attracted students, teachers and researchers all over the world. Self-regulated learning is the process by which students independently initiate and maintain thoughts, cognitive functions, emotion and behaviour in order to systematically orient towards the fulfilment of attainment of their own learning and educational goals. i.e., It refers to learning guided by motivational beliefs, metacognition, strategic actions (planning, monitoring), behavioural engagement, and emotional appraisal.

In order to understand clearly how student self- regulates their learning processes, it is necessary that the researcher should be knowledgeable on different theoretical approaches.

During the end of 18th century research on 'motivational and cognitive strategies student's use for learning' flourished. Until 1990's there had been little empirical evidence regarding how student's become masters of their own learning, – which was later termed as Self-regulated learning. These research areas got its attention when Self-regulation theories started to develop after 1980's (Zeidner, et al., 2000; Schunk & Zimmerman, 2011, Panadero, & Järvelä, 2015). The processes

in which students regulate their own learning by using different strategies has become one of the fast-growing researches in the area of educational psychology. Although each theory stem on different perspective, there is a strong consensus among theorists that successful Self-regulated learning involves a range of cognitive, behavioural and motivational strategies. Operational definitions for self-regulated learning differ on the basis of each theoretical perspective. A common conceptualization is that self-regulated learners are,

> Meta- cognitively, motivationally and behaviourally active participants in their own learning. Meta cognitively means self-regulated learners plan, set goals, organise, self-monitor and self-evaluate. Motivationally mean self-regulated learners have high self-efficacy, self-attribution and autonomy. Behaviourally means decisions and actions made by learners in order to optimise their learning environment such as selecting, structuring, and creating environment that optimize learning. Self-regulated learning strategies refers to actions and processes such as self-evaluation, organization, goal setting, planning, memorizing, rehearsing, etc. (Zimmerman,1986;1990)

The successful use of these strategies enhances learning while students complete their academic work (Schunk & Zimmerman, 2011; Panadero, & Järvelä 2015; Panadero, 2017).

There are four common assumptions on how students can self- regulate, that form the basic foundation on which each theory is built upon. It can be summarised as, firstly, based on the task and prior knowledge or experience, (a) learners set

specific goals. Then they (b) engage in constructive processes of learning. During and after a task completion they (c) monitor and regulate cognitive, behavioural, motivational and emotional processes using different forms of strategies and, it is also assumed that (d) Self -regulation mediates the relationship between academic performances, situational or environmental factors and student's personal characteristics. There are also common agreements among researchers on assumption about strategies that are used by effective learners to regulate their learning processes. (Pintrich, 2004; Moos & Ringdal, 2012; Panadero, 2017)

Self-Regulated Learning – Models

From literature, different models have been identified and explained in detail in following paragraphs. Major models are:

- Socio-Cognitive Model
- Emotion Regulation Model
- Information Processing Model
- Motivation Centred Model
- Socio Cultural Learning Model

Socio-Cognitive Model. Zimmerman was one of the first theorists who have worked in the area of self-regulated learning (Zimmerman, 1986). His researches on how individual learners acquire knowledge and become experts in their learning processes have made him one of the competent self-regulated learning researchers (Panadero & Alonso-Tapia, 2014; Panadero, 2017). Zimmerman has developed three models based on socio- cognitive perspective.

His first model (figure 1), Triadic analysis of self-regulated learning is based on Bandura's triadic model of social cognition. In this model he represents triadic interaction among three forms of self-regulated learning strategies. Those strategies are:

- **Environment:** feedback from teacher
- **Behaviour:** engage in a task
- **Person:** belief about success (Zimmerman, 1989; Panadero, 2017).

The second model is the cyclical phase model. Zimmerman explained self-regulated learning as interrelationship between cognitive, meta-cognitive and motivational processes at an individual level. This is the most famous Zimmerman's cyclical phase model (Zimmerman, 2000; Panadero, 2017).

According to the Cyclical phase model (figure 2) , self-regulated learning has three phases,

1. **Forethought phase**
2. **Performance phase**
3. **Self-reflection phase**

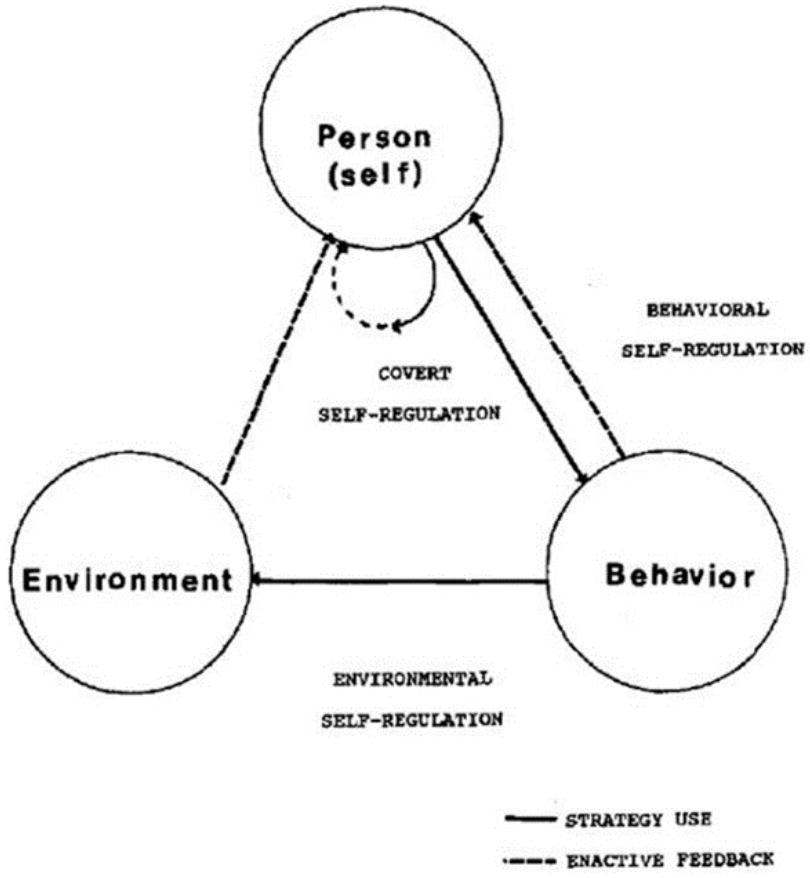

Figure 1. Zimmerman Triadic Model, Adapted from Zimmerman (1989)

Self-regulation starts from the First phase, named as **Forethought phase** – In this phase students approach their task and analyse the task by assessing their capacity to do the task successfully. Along with-it students also set goals and plan how to complete it. Whether the students act according to the plan depend on motivation. Motivation of student depends on their *self-efficacy*. If self-efficacy is high, motivation to do the task will increase and if it is low, vice versa. Efforts student put in a task also depend on *outcome expectations*- belief about rightful success of a task. *Interest and task value* will also increase the initial motivation to do the task. *Task value* means value or importance students give for the task, based

on personal goal. If students believe task is useful, motivation to do the task will increase, thus activating more learning strategies. Interest is the positive emotion students associate with a task based on task value. Another important variable which influence motivation is *goal orientation*- student's belief about influence of the task (Zimmerman, 1989; 2002; Panadero, 2017).

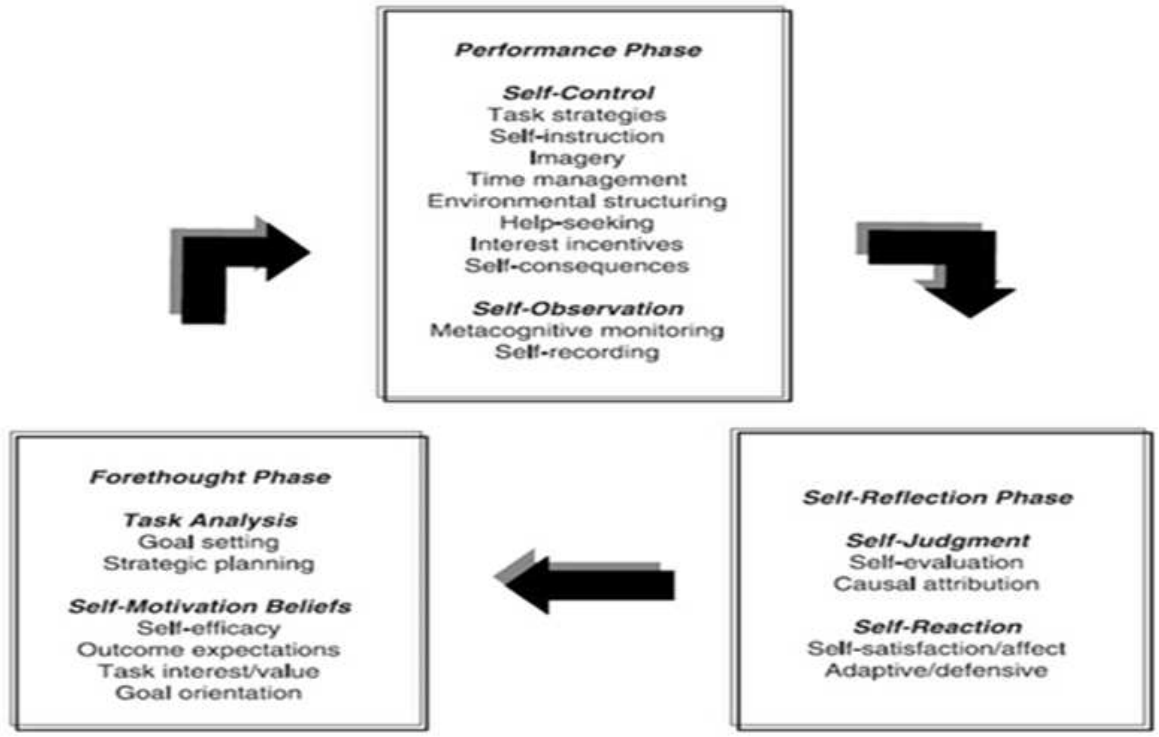

Figure 2. Zimmerman Cyclical phase model, Adapted from Zimmerman and Moylan (2009)

Second phase is **Performance phase.** In this phase students actually perform the task by using appropriate self-control strategies. In order to maintain motivation, they have to *self-observe* and *self-control*.

To self-observe properly students can use two types of strategies. First is *self-monitoring (metacognitive monitoring)* – comparing performance against the

criteria that assess quality of performance. Self-assessment occurs after completion of a task but self-monitoring occurs during a task performance. Second strategy for self-observing is *self-recording*- coding different actions done during performance of task. E.g.: noting down how much time spent for reading a text (Zimmerman, 1989; 2002; Panadero, 2017).

Self-control: In order to maintain concentration and interest students use six strategies of metacognitive nature and two strategies of motivational nature. E.g. *Specific Strategy :* if task is clearly known (for e.g.: underlining text while reading to help remembering most important parts), *Self-instruction* (self-verbalisations in the form of orders or descriptions about the task-for e.g.: steps to be taken while solving maths exercise*), mental imagery* (creating a visual maps with images – for e.g. while describing a landscape), *time management, environmental structuring* (sitting down to perform a task after collecting all the materials needed for task performance) *helps seek*ing etc, and motivational strategies like *interest incentives* (verbal incentives like saying aloud, "I will find a way to solve this problem') and *self-consequence* (self-praise and self-reward when each small goal is attained) (Zimmerman, 1989, 2002; Panadero, 2017).

Final phase of this model is **Self-reflection phase**. During this phase students *self-judge* their performance by *self-evaluation* and *causal attribution*. Self-evaluation of their performance is based on an assessment criterion (developed with help of a teacher) and based on performance goals students set up before the beginning of a task. Based on success or failure in a task, students *self-formulate* and explain the reason for failure and success. *Self-reaction* also occurs in self-reflection

phase. While justifying their success or failure students experience positive or negative emotions based on the *attribution* they formed. These emotions will influence their motivation and regulation in future. Two processes occur as part of self-reaction – *self-satisfaction* (affective and cognitive reactions that students experience while judgment) and *taking adaptive or defensive decisions* (if students take adaptive decision, students will perform task again by making slight changes in strategies they used earlier and in defensive decision students stop doing that task again to avoid failure again) (Zimmerman, 1989, 2002; Panadero, 2017).

Recently he developed third model known as multi-level model that also represent instruction and acquisition of self-regulation processes to self-regulatory competence. But the cyclical model is most emphasised one in literature (Zimmerman, 2000; Panadero, 2017).

Emotion Regulation Model. Boekaerts is one of the earliest theorists to study self- regulated learning and proposed her first model in 1991. In her model, she tried to explain the role of goals in Self- regulated learning and developed a situation specific measure of self- regulated learning. She also applied self - regulated learning to clinical psychopathology (Boekaerts, 2011; Panadero, 2017). There are two models:

- **Structural model (there are 6 components based on different strategies),**
- **Adaptable learning model**

First, she developed a structural model in which self-regulation was divided

into six components, which are: (1) domain-specific knowledge and skills, (2) cognitive strategies, (3) cognitive self-regulatory strategies, (4) motivational beliefs and theory of mind, (5) motivation strategies, and (6) motivational self-regulatory strategies. These were organized around, what she then considered to be, the two basic mechanisms of SRL: cognitive and affective/motivational self-regulation. (Panadero,2017)

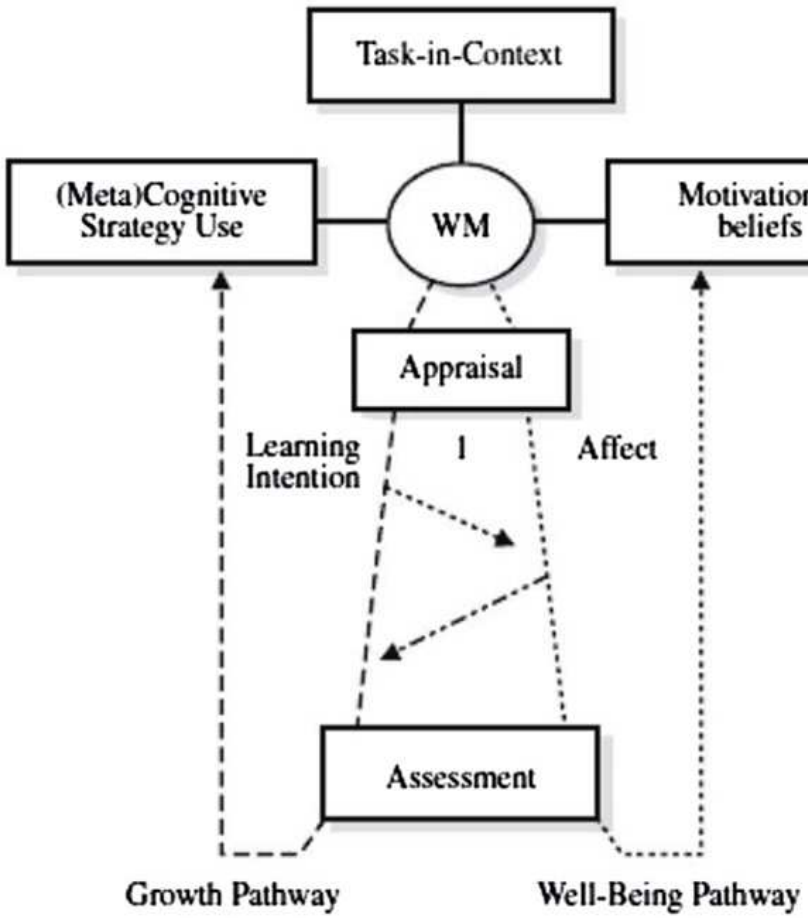

Figure 3. Dual Processing model, Adapted from Boekaerts (2011)

In later part of her research she focused more on Adaptable learning model which was later developed into well explained Dual processing model (figure 3).

This model uses different psychological theories to explain self - regulated learning, such as motivation, meta cognition, self- concept and learning. There are two parallel processing models: (a) *learning mode or mastery mode* and (b) *coping mode or well- being mode*. Students activate knowledge structures that guide their behaviour (goal pathway) based on students' judgement of task. Evaluation of the task triggers *positive or negative emotions or cognitions*. If negative emotions and cognitions are activated, students protect their ego and move to *well- being pathway*. If positive emotions are triggered, they move to *mastery pathway* as they perceive the task is comparable with their goal. While on moving on through mastery pathway, if they experience any threat or cues of threat students immediately move to well- being pathway. In well- being pathway *"bottom- up"* strategies are activated to protect self from damage. In Mastery pathway *"top- down"* strategies are activated for achieving task goals. Goals for achieving task are formed based on need, value and personal goal. When shift from mastery goal to well- being pathway occur due to external (teacher, parent or peer pressure) or internal (self -thoughts) students redirect their strategies. Therefore, emotions are essential in this model because positive and negative emotions formed by goal appraisal trigger which pathway student's use. Recently, Boakaert's have proposed different emotion regulation strategies students may use in their learning processes (Boekaerts & Corno,2005; Boekaerts & Cascallae, 2006; Boekaerts, 2011; Panadero, 2017).

Information Processing Model. In this approach, Winne (Butler &Winne,1995) present self-regulated learning from an information processing perspective as the theory is grounded in the basic principles of cognitive psychology

i.e. Students are active learners. They control and monitor their learning processes through metacognitive strategies (Butler & Winne 1995; Winne, 2011; Panadero,2017). Their model has undergone continuous revision. In the first version, internal feedback is presented and in the second version, Winne explored different profiles a goal can take and also discussed about difference between goal aim and current state of work monitoring. In third version, reflections on meta-cognitive aspects are introduced. In 1997, Winne presented the COPES model (figure 4). The model was well explained in 1998 with support from Hadwin, thus Winne's model came to be known as Winne and Hadwin model (Butler & Winne1995; Winne, 1997; Winne & Hadwin, 1998; Panadero, 2017).

Self-regulated learning occurs through loosely sequenced and recursive (Winne, 2011) four phases in a feedback loop. The four phases are:

- **Task definition**: students define their task and comprehend the task to be done
- **Goal setting and planning**: students define their goal and plan strategies to reach their goal
- **Enacting study tactics and strategies**: strategies planned by students are performed in action
- **Metacognitive adapting:** metacognitive adaptation occurs when the whole main processes are completed and students make long term changes in motivation, belief, and strategies for future achievement (Panadero, 2017).

Additionally, Winne and Hadwin (1998) proposed five different aspects of tasks that can occur in four different phases and identified it through acronym COPES. In Self-regulated learning students engage in tasks. Each task can be represented as five-part schema – Conditions, Operations, Products, Standards and Evaluations- the COPES model (Winne 1997).

Conditions: Students perception on what are the resources available for working on the task and what would be the constraints that can affect work on the task. Constraints can be internal conditions or external conditions. Internal conditions are students' characteristics such as knowledge about task, study tactics, learning strategies, motivational orientation, and epistemological beliefs. External conditions are characteristics of context or environment that students perceive that can influence internal conditions of either one of the next two aspect of the task known as operation and standards.

Operation can be explained as the cognitive processes, tactics, and strategies that work on information and represented as acronym –SMART (Searching, Monitoring, Assembling, Rehearsing, and Translating) . Operations create information which can be a new knowledge or it can relate to goal of task known as Products.

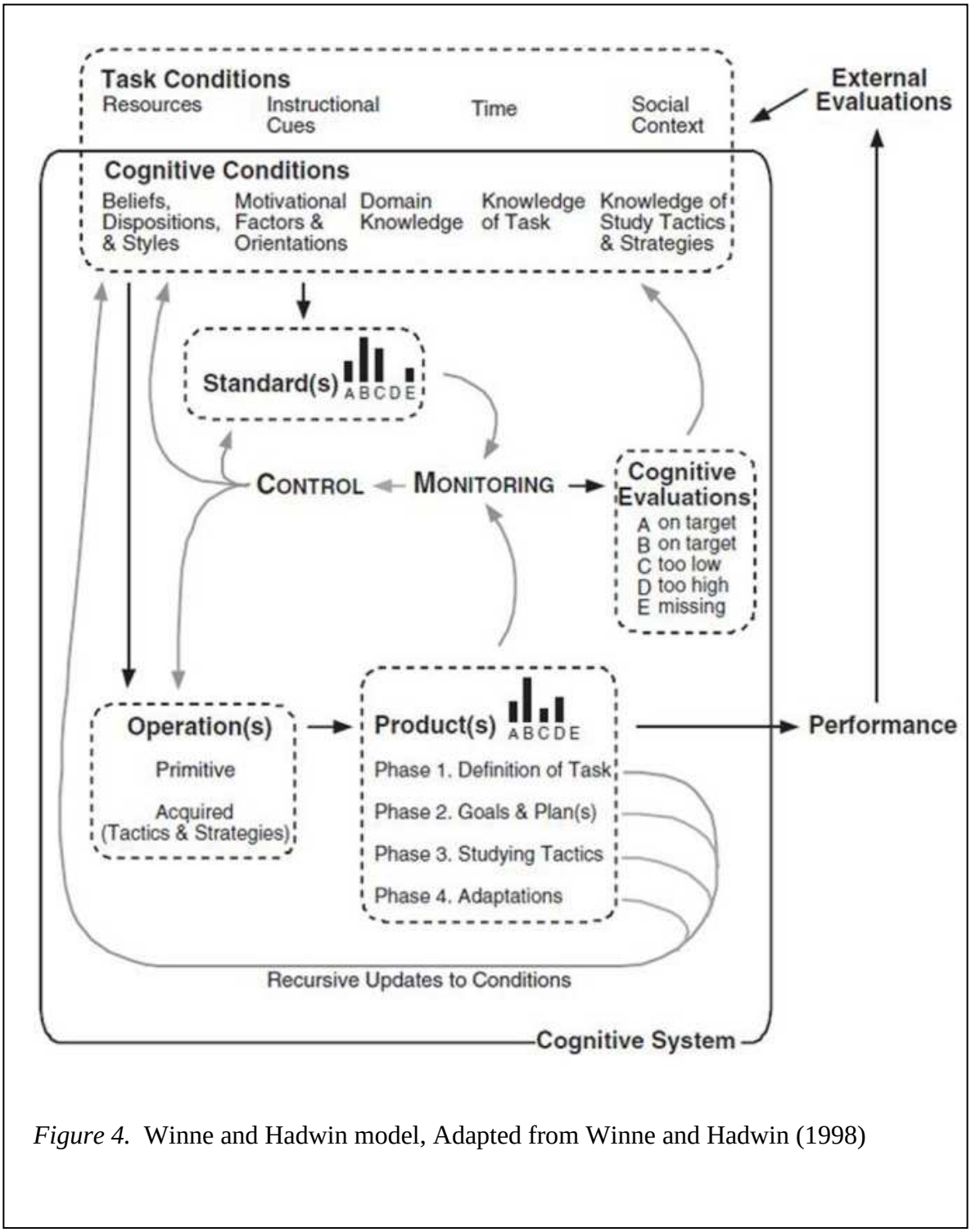

Figure 4. Winne and Hadwin model, Adapted from Winne and Hadwin (1998)

Products are also formed by metacognition- eg: judging whether the information is worth full for creating a mnemonic versus just memorising it.

Evaluation: feedback about the fit between products and standards, either internally by student or externally by other sources eg: teacher.

Standards: Products are evaluated against certain criteria

(Definitions are taken from Winne, 1997; Winne & Hadwin ,1998; Panadero,2017; Winne et al 2010). Later on, Winne focused on meta-cognitive aspects while Hadwin continuously supported by giving empirical evidence and additionally focused on situational, contextual, and motivational aspects of collaborative learning and developed socially shared regulated learning (SSRL) along with Jarvela and Miller (Panadero,2017).

Motivation Centred Model. Pintrich is one of the researchers whose work mainly focused on clarifying and emphasising the role of motivation in Self-regulated learning. (Pintrich, et al., 2000; Panardo, 2017). The theoretical and conceptual frame work of self -regulated learning is clarified by conducting empirical and theoretical research. There is only one version for his model (Pintrich & Groot,1990; Pintrich,2000; Panadero, 2017).

In Pintrich Self-regulated learning model (figure 5), Self-regulated learning processes are organised in a general sequence and students undergo these processes while carrying out a task. It is not hierarchically or linearly structured. Phases can occur simultaneous and dynamic and form multiple interactions. Further Pintrich also indicate that it is not necessary that all phases occur for all academic tasks. Self-

regulation need not be always explicit, it can occur implicitly and automatically based on earlier experience (Pintrich, *et al.,* 2000; Montalvo & Torres,2004; Panardo 2017). Self-regulation has four phases and each phase of Self-regulated learning are structured into four areas based on strategies used i.e. cognitive, motivation, behaviour and context. The four phases are:

- **Forethought, planning and activation**
- **Monitoring phase**
- **Control learning**
- **Reaction and reflection phase**

TABLE 1 Phases and Areas for Self-Regulated Learning

	Areas for regulation			
Phases	Cognition	Motivation/affect	Behavior	Context
1. Forethought, planning, and activation	Target goal setting	Goal orientation adoption	[Time and effort planning]	[Perceptions of task]
	Prior content knowledge activation	Efficacy judgments	[Planning for self-observations of behavior]	[Perceptions of context]
	Metacognitive knowledge activation	Ease of learning judgements (EOLs); perceptions of task difficulty		
		Task value activation		
		Interest activation		
2. Monitoring	Metacognitive awareness and monitoring of cognition (FOKs, JOLs)	Awareness and monitoring of motivation and affect	Awareness and monitoring of effort, time use, need for help	Monitoring changing task and context conditions
			Self-observation of behavior	
3. Control	Selection and adaptation of cognitive strategies for learning, thinking	Selection and adaptation of strategies for managing motivation and affect	Increase/decrease effort	Change or renegotiate task
			Persist, give up	Change or leave context
			Help-seeking behavior	
4. Reaction and reflection	Cognitive judgments	Affective reactions	Choice behavior	Evaluation of task
	Attributions	Attributions		Evaluation of context

Figure 5. Pintrich model, Adapted from Pintrich (2000)

Self-regulated learning starts in the First phase, *Forethought, planning and activation*. In this planning phase Students use three types of *cognitive regulation*, (a) They set target goal, (b) Activate prior knowledge related to context of material, (c) Activation of metacognition knowledge such as – accepting and understanding difficulties in each task, identify knowledge and skills needed for each task, knowledge about resource and strategies needed for completing task. Students also use *motivation regulation* to activate motivation beliefs such as judging self-efficacy, judging the ease of learning, perception of difficulty of task, activating the value given for task, activating interest of task and adopting goal orientation. Students plan the time and effort to be used in task along with planning for self-observation of behaviour as part of *behaviour regulation*. Context and task perception regarding the task happen as part of *contextual regulation* (Pintrich, et al., 2000; Montalvo & Torres, 2004; Panardo, 2017).

In second phase, *monitoring phase,* students use different regulation strategies to become aware of and monitor meta cognitive observation, motivation and emotion, effort, time used, need for help, task and content conditions (Pintrich, et al., 2000; Montalvo & Torres, 2004; Panardo, 2017).

In the third phase, based on responses and results from first two phases, students *control learning* using four regulation strategies. In *cognitive regulation*, students select and adapt to cognitive strategies for learning and thinking. They also select and adapt strategies for managing *motivation* and *emotion* along with *behaviour strategies* such as increasing or decreasing effort and either by persisting in task activity or giving up. Based on their behaviour strategy they use *context*

strategy such as change or reorganise task or change or leave content (Pintrich, *et al.*, 2000; Montalvo & Torres, 2004; Panardo, 2017).

The final phase, *reaction and reflection phase* occur when students use *cognitive strategies* such as cognitive judgments to compare against previously established criteria of his/her own or the teachers. Attributions are made regarding the cause of successes or failure. Based on their attribution made in *motivation regulation* they experience affective reaction. As a consequence, they show help seeking *behaviour regulation* or set choice behaviour to be followed in future. As part of *context regulation* they make general assessment about task and context (Pintrich, *et al.*, 2000; Montalvo & Torres, 2004; Panardo 2017).

Socio Cultural Learning Model. First researches on Self-regulated learning mainly focused on individual learning situations (Panadero & Jarvela, 2015). The idea that human is a social being and learning can also occur in social context and the fact that Zimmerman's (1989) model of Self-regulated learning is grounded in the principle of social context and reciprocal role of environment led to researchers such as (Hadwin et al., 2017) to focus on social aspect of Self-regulated learning (Panadero & Jarvela, 2015).

Based on (Hadwin et al., 2017) SSRL (socially shared regulation of learning) model there are three different types and three different levels of regulation that can happen while working as a collective group on a collaborative task (Panadero, et al., 2015; Panadero, 2017).

First, *Self-regulation* (SRL): While working in a group, individual need to activate their own strategies and have their own goal which may or may not be aligned with group goals. So individual student has to regulate their learning (cognitively, metacognitively, motivationally, emotionally, and behaviourally) to adapt to the interaction with the other group members i.e Achieving success in collaborative tasks depends upon the skills and strategies students bring to the group (Panadero et al., 2015; Panadero, 2017).

Secondly, *Co-regulation* (CoRL): Co regulated learning occur usually when head of the group promote and influence by planning and coordinating other group members regulation. This stimulates appropriate strategic planning action, reflection and adaptation. Achieving success in collaborative tasks depends upon: support provided to one another to facilitate self- regulatory competence within the group (Panadero & Jarvela, 2015; Hadwin et al., 2017; Panadero, 2017).

Finally, socially shared regulation of learning occurs when group members jointly strive towards achieving a consensus with respect to its goals, strategies and processes. These also stimulate deliberate strategic planning, task enactment, reflection and adaptation within the group. Achieving success in collaborative tasks depends upon shared or collective regulation of learning such as successful coordination of goals and strategies (Grau & Whitebread, 2012; Jansen, et al., 2017; Panadero & Jarvela, 2015; Panadero,2017).

Hadwin conceptualized Socially Shared regulated learning in four loosely sequenced feedback cyclic loop.

> During the first loop, groups *negotiate and construct* shared task perceptions based on internal and external task conditions. Through the second loop, groups *set shared goals* for the task and make plans about how to approach the task together. In the third loop, groups *strategically coordinate their collaboration and monitor* their progress. Based on this monitoring activity, the groups can change their task perceptions, goals, plans, or strategies in order to optimize their collective activity. Finally, in the fourth loop, groups *evaluate and regulate* for future performance. (Panadero, 2017)

So, for learning to be effective, group members must commit to group work and do group work along with successfully regulating group work together as a collective to form shared goal, shared plan, shared perception on task and develop shared strategies (Hadwin et al., 2017; Panadero & Jarvela, 2015; Panadero, 2017).

Summary of Models

So far, various models and their outlines have been proposed – most of them conceptualise self-regulated learning as encompassing several interdependent processes. All these regulation processes are sequentially ordered, when explained theoretically. But in reality, when a learner occupies in a learning task multiple processes can occur simultaneously and learner can move to and fro between these processes dynamically (Zimmerman & Martinez-Pons 1986; Pintrich & Groot 1990; Ning & Downing, 2012).

Self-regulated learning models have been summarised and compared by researcher, based on three phases and strategies that can occur (Table 1). The three phases are named as:

1. ***First phase (approaching the task)***

In Zimmerman model (a) there occur- analysis of the task, goal setting and planning of strategies to be used. There is continuous effort to regulate motivation (Zimmerman, 2000; 2011). In Emotion regulation model there occur (b) activation of knowledge needed for development of course of action for enacting the task and forming emotions (Boeakaerts, 2011). In Winne and Hadwin model it is similar to Zimmerman model i.e., (c) defining the task and comprehending, goal setting and planning, (Winne,1997; Winne & Hadwin 1998). In Pintrich model there occur (d) Planning using strategies of all kind – cognitive, behavioural, contextual, motivational (Pintrich & Groot,1990; Pintrich, 2000).

2. ***Second phase (action phase)***

In this phase students move from preparing for a task to actually performing it. In Zimmermman model (a) self-observation, self-control strategies are used to maintain motivation (Zimmerman, 2000; 2011). In Boekaerts model there is 'decision taking' by (b) judgment of task, resulting in actions that make learner move from mastery to wellbeing pathway based on emotions formed (Boeakaerts, 2011). In Winne and Hadwin model (c) metacognitive adaptation occur during enacting strategies (Winne, 1997; Winne & Hadwin, 1998). In Pintrich model there is (d)

control learning using cognitive, behavioural, motivational and contextual strategies (Pintrich & Groot, 1990; Pintrich, 2000).

Table 1

Summary of Self-regulated Learning Theoretical Models

Models	First Phase - Approaching the Task	Second Phase- Action Phase	Final Phase- Self Reflection
Zimmerman Model	Task analysis, Goal setting, Planning, Motivation regulation.	Maintaining motivation using self-control and self-observation strategies.	Self-formulation and taking adaptive or defensive decision.
Boeakaerts Model	Activation of knowledge, Forming emotions.	Judgement of task and deciding of pathways.	Emotion analysis and planning for future.
Winne & Hadwin Model	Define task, Goal setting, Planning.	Metacognitive adaptation	Updating and long-term adaptation.
Pintrich Model	Planning using strategies.	Controlling learning using strategies	Judgement between goal and attainment.

3. Final phase (self-reflection)

In third phase after completing the task students engage in self-reflection. In Zimmerman model (a) based on positive or negative emotions formed after self-formulation students take adaptive or defensive decisions (Zimmerman, 2000; 2011). In Emotion regulation model there can be (b) change in plan on future strategies based on emotion formed (Boeakaerts, 2011). In Winne and Hadwin

model (c) updating and long-term adaptation in metacognitive strategy use can occur (Winne, 1997; Winne & Hadwin, 1998). In Pintrich model there is (d) forming casual attribution after making judgement between set goal and attained achievement (Pintrich & Groot,1990; Pintrich,2000). All researchers agree on three phases and disagree only on the kind of strategies students engage in.

All of these processes are emphasised as dimensions of regulations-cognition, motivation, metacognition, behaviour and emotion. Theoretically these dimensions are distinct, but in practise these dimensions are intertwined, in that the regulation of one dimension may well lead to changes in the other dimensions (Ning & Downing, 2012).

Intelligence, Academic Achievement and Self -Regulated Learning Strategies

All researchers agree the fact that there will be individual difference in ‘how a student learns in an academic environment’. This long held assumption has been supported by empirical researches (Moos & Ringdal, 2012). In earlier years educationist focused on ‘what student learn and how other psychological, physiological, and environmental factors influence what they learn’. Due to recent increased focus on regulation (self-regulation, emotion regulation, behaviour regulation) accompanied by methodological advances lead researchers to focus more on ‘how’ each student learn. This query on individual difference is not new, as Galton’s quest about human being was – ‘why individual is different’ and this simple thought of curiosity eventually lead to the rich development of theoretical back ground on the concept of intelligence. Intelligence despite the strong amble differences in definition, for the sake of measurement is commonly operationalized

as the ability to plan, solve problems, ability for abstract thinking, comprehension abilities, and ability to use language (Singh, 2015).

Even though there are long run debates and controversies about ‘what is intelligence’ and ‘how it can be measured’, there is a predominant agreement among researchers and common layman that ‘g’ or general intelligence predicts academic achievement and achievement outside school (Gottfredson, 1997; Cavojova & Mikuskova, 2015).

In an institutional environment (school, college, university) academic achievement refers to the performance outcome and also frequently represented as a measure of extent to which students has accomplished specific goal. Usually definition of academic achievement depends on indicators used to measure it. Indicators can be “procedural and declarative knowledge acquired in an educational system, more curricular-based criteria such as grades or performance on an educational achievement test, and cumulative indicators of academic achievement such as educational degrees and certificates” (Steinmayr et al., 2014). Most frequently academic achievement is operationalized as knowledge acquired by memorising and skills attained for fulfilment of reproducing content of educational standards (Singh, 2015). It is the extent to which a student has achieved short- or long-term educational goal by giving importance to declarative knowledge or facts. It is the performance outcome of domain taught at school. GPA or score sheet represent academic achievement and measured through examination. Usually research works take into account final grade or average score from different subjects. In a Kerala educational scenario, GPA or scores on a mark list determine

whether a student will have the opportunity to continue his or her education. There by, can influence career choices than the practical skills and interest.

There are research studies which shows that individual difference in academic achievement are reliable predictors of quality of life in adulthood (Power et al., 2013; Malykh, 2017). Reason for individual difference in academic achievement hasn't loosen its relevance for years and different psychological constructs have been considered as predictors of academic achievement (Malykh, 2017). Of these, personality and intelligence have extensive research. But intelligence have the upper hand, since intelligence tests have its origin as predictor of academic success or failure (Ackerman & Heggested,1997; Laidra et al., 2007). Also, there are rich source of literature stating the relationship between intelligence and academic achievement. Studies most often report a positive strong relation between Intelligence and academic achievement. The power or coefficient of correlation range between 0.4 - 0.7 and usually end up around 0.5, (Neisser, et al., 1996) depending on the school, subject, year of education, selection of sample and so forth. Fluctuations in effect size can also be attributed to tool used to measure intelligence. 0.5 correlations mean a prediction power of only 25%. (Mackintosh, 2011; Duckworth & Seligman, 2005; Tatlı & Ergin, 2017; Malykh, 2017). The relationship has been explicitly stated as:

> The relationship between test scores and school performance seems to be unambigious. Wherever it has been studied, children with high scores on tests of intelligence tend to learn more of what is taught in school than their lower-scoring peers. There may be styles of teaching and methods of

> instruction that will decrease or increase this correlation, but none that consistently eliminates it has yet been found. (Cronbach & Snow, 1977)

There are researches which argued that both intelligence and personality should be taken into account when predicting academic achievement (Laidra et al., 2007; Chamorro-Premuzic and Furnham, 2005). In finding personality factors influencing student's achievement, interest and motivation had significant effect (Noeryanti et al., 2018). But other researchers strongly argue for intelligence, stating that the individual difference in academic achievement is mainly explained by differences in level of intelligence (Malykh,2017).

Longitudinal studies show that predictive power of intelligence over academic achievement decrease from primary school years to high school years. (Laidra et al., 2007, Malykh 2017)

Even though relationship between intelligence and academic achievement is a debated topic in literature a considerable number of correlation studies can be seen between measures of intelligence and, measures of academic performance. As 'g' is commonly acknowledged as determinant for intellectual tasks, it is thought to be precedent for academic tasks.ie. scholastic tasks are 'g' demanding (Jensen, 1998, Luo et al.,2003) and suggest that source of correlation between intelligence and academic tasks are not clear. This research is an attempt to find the same through Self-regulated learning.

This study assumes that intelligence is the basic predictor as it theoretically explains what is possible for student to achieve and second predictor is personal

variables. As of the many variables studied most variability has been found in personal factors that predict academic achievement (Skuy, 2003). It is assumed that personal factors influence academic achievement indirectly through student's approach to work and decide how student convert intelligence into academic achievement. According to past empirical evidence, personal factors such as Self-control (Muammar, 2015), goal orientation (Steinmayr et al., 2011), interact with intelligence (Stumm & Furnham, 2012). Present research assume personal factors can be emotional, behavioural, motivational or cognitive variables. The success of student mainly depends on ability to successfully regulate these personal factors. Regulation occurs through use of different strategies. For easiness of measurement, in this study personal factors have been conceptualised as strategies used by students, under the term self -regulated learning strategies.

To understand and conceptualise the different pathways that may occur in complex relationship between intelligence, self- regulated learning strategies and academic achievement, a reviewing of literature had been carried out through following paragraphs.

Literature Review

Exploration on self-regulated learning has its roots in general studies of self-control and self-regulation. Scholars found hopeful indications in children's use of self-regulation processes such as goal setting, self-reinforcement, self-recording and self-instruction in the areas of self-control habits such as eating and other routine tasks. This has encouraged educational researchers to study self-regulation of children during academic learning task. Researchers in the area of self-regulated

learning share a common belief that student's understanding and being aware of their own learning processes and strategies to regulate learning processes are critical in studying academic achievement (Zimmerman, 1989;1986; Cassidy, 2011).

As self-regulated learning has its origin in studies that focus on improving academic achievement there are numerous studies which focus on its relationship with academic achievement and most studies consistently report that students who use self-regulated learning strategies effectively for learning obtain high academic achievement and various studies reveal that self-regulated learning enhances students' academic success (Zimmerman & Schunk, 1989;Pintrich & Groot, 1990; Pintrich, 2000; Camahalan, 2006; Cazan, 2014; Rowe & Rafferty, 2013). While, there are also other researchers who also reported no significant relationship with academic achievement and self-regulated learning (Shaine, 2015; Ergen & Kanadli, 2017).

Although most studies find positive relationship between academic achievement and self-regulated learning, sub variables which show strong and weak relationship vary according the tool selected by the researcher. Most of the education researchers measure academic achievement as GPA score obtained by participant. Some studies report GPA scores of particular subjects of their interest. Participants of research ranged from elementary school students, high school students to college level, and some studies are on online students and some on distant learners. Even though there is no scientifically developed intervention module for self-regulated learning, some studies report using interventions. Few of the relevant studies are discussed below.

Self- Regulated Learning and Academic Achievement

There are studies which report that self-regulated learning strategies applied by a student predict his/her achievement, while there are also few studies which report that high achievers consistently utilize some self-regulation strategies more frequently than low achievers.

Some studies reported that high achievers are self-regulated learners (Schunk & Zimmerman, 2011) while other studies report self-regulated learners set goals for learning more frequently, use more learning strategies, are self-aware of their learning process and are more systematic and have high grades (Pintrich & Groot, 1990; Pintrich, 2000; Pintrich & Zusho, 2002).

Recent researches also show that high academically oriented students use more self-regulated learning strategies than lower academically oriented students (Yip, 2007; Rowe & Rafferty, 2013; Soufi, et al., 2014; Ning & Downing, 2012). Also, there are investigations that report differences in level of academic achievement based on level of self-regulated learning strategies applied by students (Heikkila & Lonka, 2006; Zimmerman & Schunk, 1989).

A research study considered self-regulated learning strategies in college students. Self-efficacy and effort regulation were strong predictor of achievement and intrinsic motivation correlated with grades, however, extrinsic motivation did not (Lynch, 2006).

A study by Peng (2012) in college students of china found positive relationship with self-efficacy, intrinsic value and cognitive strategies and

performance in English examination measured by Grades. Among them self-efficacy (Self-efficacy is a sub variable of motivation strategies) has the strongest influence and test anxiety was negatively correlated with academic performance. In turkey, Inan (2013) found significant positive correlations between three dimensions of self-regulated learning strategies (i.e. motivation and action to learning, planning and goal setting, strategies for learning and assessment) and GPA scores. Similar to Peng (2012) and lynch (2006) study they could also find highest correlation between motivation and GPAs. They also reported negative but not statistically significant correlation between lack of self-directedness and GPAs of participants. In the same year, in Turkey, Altun and Erden (2013) explored learning strategy used for mathematics achievement. Finding indicate that 'metacognitive self-regulation', 'regulation of time' and 'study environment', 'help seeking' and 'self-efficacy perception' were significant factor in exploring mathematics achievement, while effort regulation was not.

A study on primary school students revealed that self-efficacy, self-regulation and cognitive strategy use jointly explained 44.8% of variance in academic achievement and only self-efficacy was significant predictor of self-regulated learning strategy (Shaine, 2015). It is also expected because Peng (2012), Inan (2013) report high correlation between self-efficacy and self-regulated learning. This was first suggested by Zimmerman & Martinez-Pons (1990) that students with high self-efficacy, use self-regulation strategies more frequently. Also, indorsed by Pintrich and Groot (1990) that there is a relationship between self-efficacy and self-

regulation. Bozpolat, (2016) propose that there are parallel changes between self-regulated learning strategies and academic self-efficacy.

Study by Bozpolat (2016) revealed the effect of general academic average variable on self-regulation strategies and he reported several studies, but unfortunately most of the studies they reported are published in non- English language.

While most studies defined Self-regulated learning as frequency of applying self-regulated learning strategies and academic achievement as GPA score obtained, Cheng (2011) operationally define it as student's perception of applying self-regulated learning strategies (For e.g., Can I summarise the main idea of the text?) and academic achievement as perception of learning effectiveness. Multiple regression analysis showed that student's (from secondary schools in Hong Kong) self-regulated learning sub variables such as, 'learning', 'motivation', 'goal setting', 'action control' and 'learning strategies' played a significant role in their learning performance.

Numerous studies use empirical method to study self-regulated learning using questionnaires, very few report interview methods, although earlier self-regulated learning studies by Zimmerman and Martinez- Pons (1986) was of qualitative style. In one review by Yildizli and Saban (2016) they report, effect of intervention on self-regulated learning on sixth grade Turkish students' mathematics achievements using both quantitative and qualitative research methods. 'Self-efficacy' and 'goal orientation' were the two motivational variables studied under quantitative study and found to be significantly related to mathematics

achievements. The qualitative data obtained through interviews and document analysis during and after the experimental process further revealed that students started to see math as fun, like it more, grasp the importance of it in everyday life, build more self-confidence, set specific targets for themselves, and monitor their learning process.

Malpass et al., (1999) research study in mathematically gifted, mostly Asian American, high school students by using structural equation modelling framework established that self-efficacy is positively related to math achievement but learning goal orientation (or intrinsic value) was not related to mathematics achievement.

In Turkey, using academic self-regulated learning scale developed by Mango (2011), Cetin (2015) reported no correlation between GPA and academic self-regulation learning. The prediction power of self-regulated learning in distant learners was explored by Bruso & Stefaniak (2016) in U.S. Their results indicated that neither instrument (MSLQ was aimed to quantify student motivation and the OSLQ was intended to include self-regulated learning) predicted students' academic achievement measured by GPA.

A few meta-analyses researches can also be seen in literature. Whose result confirm effects of self-regulated learning are consistent regarding the general positive impact on academic achievement and learning motivation (Zimmerman & Bandura, 1994; Zimmerman, 2002; Dignath & Buttner, 2008; Dent & Koenka, 2015).

Focusing on students' academic performances, Dignath and Buttner (2008) had done meta-analysis of intervention studies one for primary school students and another for secondary school students. They reported that for primary school students self-regulated learning strategies training had high effects, but for secondary school students meta-cognitive strategies training had high positive effect. Early school students have less developed self-reflection skills and have less control over their learning than secondary school students. For primary school students, training cause high effect on maths performance while read/ writing performance increased effectively only when they reach secondary school. They reported that students develop a negative achievement belief for maths as they grow, more than other disciplines. These low self-efficacy beliefs tend to lower the effect of intervention on maths for secondary school students.

Dent and Koenka (2015) applied two meta-analysis one on metacognitive processes and other on cognitive strategy use. They also conducted five moderator analysis for specific processes, academic domain, grade, self- regulated learning measuring method and type of academic achievement measure. Their result showed metacognitive strategies had strongest correlation with academic achievement, among them, 'planning' had strongest correlation and all other specific sub processes had weaker correlation. 'Planning' when combined with 'goal setting' also weakened the correlation. Meta- cognitive strategy like, 'deep processing' had stronger correlation with academic achievement. Meta cognitive strategy and cognitive strategy obtained stronger correlation more for social science achievement, then for science, then for English and at last for maths. Across grade level, different

pattern could be seen for both analyses. For cognitive processes, correlation increased gradually from elementary school to middle school to get strongest at high school. But for meta-cognitive processes elementary school had strongest correlation, declining at lower primary, but increased in upper primary and then decreased again in high school. Meta-cognitive processes had high correlation with standardized achievement test, then with GPA score and least correlation with structured interview. For cognitive processes strongest correlation was obtained for GPA and correlation was weak for standardized tests.

In 2017, a meta-analysis was carried out by Ergan and Kandali to calculate common effect size of studies on self- regulated learning and academic achievement, conducted in Turkey between 2005-2014, to know if effect size varies based on course, self-regulated learning strategy type, grade level and study designs. They reported that self-regulated learning strategies have a strong effect on academic achievement. But calculated effect size did not vary for self-regulated learning strategy, course type, study design, and school level (Ergen, & Kanadli, 2017).

Most of the research studies discussed here, focused on self-regulated learning from a variable centred approach i.e. the relationship between self-regulated learning variables and the student outcomes, but some researchers adopt person cantered approach, in which profile or clusters were formed based on each participant's self-regulated learning level. In these studies, either their level of strategy use predict membership to a specific profile group (high SRL, low SRL, and average SRL) or a particular cluster would have similar set of adaptive self-regulated learning characteristics (Abar & Loken, 2010; Liu et al., 2013; Ning &

Downing, 2012) and students in these profiles or clusters have significantly different academic outcomes (Barnard-Brak et al., 2010).

Effect of socio-demographic variables on self-regulated learning

Effect of gender and class level on self-regulated learning was examined by Yildiz, et al., (2018) a significant relationship was found between competency levels and self-regulated learning strategies for males. They also observed that student's motivational, cognitive and metacognitive competencies levels increase as their grade levels increase.

Contrary to above result Bozpolat (2016) reported that females use more strategies than male counterparts. Biologically and physiologically there are sex differences in humans and based on such differences gender perception usually differs across culture. Motivation and effect of gender on learning strategy use is different for both sexes. Effect of Self efficacy perception and use of self -regulated learning strategies on academic achievement of university students was studied by Altun and Erden (2013). Positive relationship was found between the self- regulation learning strategies and self- efficacy perceptions of university students and their mathematics achievement. Metacognitive strategies, time and study environment, help seeking and self- efficacy perception have a meaningful effect on explaining the variance in mathematics achievement. Metacognitive strategies, time and study environment, help seeking and self- efficacy perception are important in explaining boy's mathematics achievement while effort regulation is the only variable found important in explaining girl's mathematics achievement (Altun & Erden, 2013). However, a more contradicting result was suggested by Zimmerman and Martinez-

Pons in (1989), that gender have no significant difference in the self-regulated learning strategy, especially in self –efficacy.

Research in India

In India, Self -regulated learning is not studied extensively when compared to other countries. Investigator could identify only few research works and some PhD thesis related to self -regulated learning. Studies focuses mainly on amount of contribution of Self- regulated learning to academic achievement, variables contributing to self-regulated learning and difference in self-regulated learning across different types of subgroups based on socio demographic data.

Dangwal and Thounaojam (2011) analysed a case study for understanding how minimally invasive education foster self- regulated learning behaviour in an Indian context, particularly in slum and rural areas. Slum children when exposed to learning situation without adult participation, actively construct their own knowledge and develop critical insights into how they think. This increased their curiosity, they became self-motivated, started collaborative learning, organised their learning behaviour and optimised their learning processes. Thus, through their single case study authors prove ‘Hole in the wall pedagogy’ cause to induce self- regulated learning traits which has driven slum children’s interest toward formal school education.

Azizi and Yeshodhara (2014) in their study found Self- regulated learning strategies contributed more to Academic achievement than internet competency. They found significant difference between male and female in internet competency

and practise of self- regulated learning strategies. They couldn't find significant difference in strategy use based on main subject chosen by the students. Authors conclude that self- regulated learning strategies (mainly- elaboration strategy and effort regulation strategy) is better predictor of and contribute more to Bachelor students' academic achievement. But, Pote and Kute's (2018) survey among under graduates found that self-regulated learning had only a weak positive, yet significant relationship with academic achievement.

Difference in self-regulated learning of high creative group and low creative group was studied by Joshi and Shukla in (2012). They found differences in self-regulated learning of high and low creative students. They discussed the differences based on each dimension specifically. High creative group also have high academic achievement.

A systematic review was conducted by Gafoor and Kurukkan in (2016), among studies which specify mathematics achievement and self-regulated learning from 1998 to 2016 but not specific to Indian population. Their review suggested that meta-cognitive strategy use was affected by goal orientation. On the other hand, reward was affected by student's achievement level and prior knowledge, Pattern of self -regulated learning across different subject level were seen but no specific commonality can be observed.

Kumar and Meenu (2016) investigated differences in self-regulated learning for students of continuous evaluation system and annual evaluation system. They found self-regulated learning behaviour is high for students of continuous evaluation system. They further discuss the reason and advantage of the same.

Sindhu and Bindhu (2017) explored the contributing variables for self-regulated learning in physics. They found parenting style, class room climate and academic delay of gratification had significant main effect on self- regulated learning and were predictors of self- regulated learning. Among these variables academic delay of gratification was the highest contributing factor to self- regulated learning.

The above-mentioned researches had viewed self-regulated learning from a general perspective. Shams and Imtiaz (2018) studied self-regulated learning from a narrow specific context. They explored self-regulated learning strategies and reflective practices adopted by students of English during their writing practices. Most commonly used strategies for writing were planning, monitoring, organising, and pre-planning. Differences in strategy use by English as a foreign language student and English as a second language student were also discussed.

Intelligence and self-regulated learning

It’s easy to assume quickly that highly intelligent individuals will show high rate of self-regulated learning and they will perform strategies more efficiently and profit more from training (Sontag, et al., 2012). But this is not the case. One can also assume that gifted students use fewer strategies, as they have more cognitive abilities and capacities. In research about intelligence and self-regulated learning, findings often show inconclusive results about its relationship. There are only very few studies on intelligence and self-regulated learning. Moreover, the reviews available had focused more on gifted students (Sontag & Stoeger, 2012).

Older studies of student effectiveness on strategy training found gifted students were more capable of understanding strategy, retain it, and apply it and teaching others about it. This assumptions was elaborated by Scruggs, et al., (1986) to find that both students benefitted from training but only gifted students could apply it to new situation. Gifted and average student's ability to self-regulate in a verbal concept identification task was compared by using think aloud protocol, Bouffard –Bouchard et al., (1993) found both group were equal in 'planning' and 'motivation' strategies but differed in 'time management' and ' persistence on reworking the problem' strategies. The differences between gifted and intelligent students are not in specific strategies they used but in effort they invested in the task. Gifted students were more systematic in use of cognitive strategies and gifted students are those students who are capable of effectively using their skills. Effects of giftedness were more prominent in metacognition regulation strategies (Bouffard -Bouchard et al., 1993).

Zimmer and Martinez-pons (1986) compared students based on their achievement tracks of school. Student's membership in high or low achieving group could be predicted with 93% accuracy using their self-regulated learning strategy use. And found self-regulated learning strategy use were best predictors than Socio economic status. They could find that high achievers used more (almost 13) cognitive strategies, - 'repetition' and 'memorization' as well as 'read notes once again' more frequently than low achievers. But when Zimmerman and Martinez-pons (1990) compared between gifted and average students, differences only occurred for 'reviewing notes strategy'.

Sporer (2003) interviewed German students to know more about ‘cognitive strategies’ they applied in a learning task and found more intelligent student used elaboration strategies more often than average intelligent student. These results were contradicted by Dresel and Haugwitz (2006) and report no relationship between IQ level and frequencies of using ‘elaboration strategy’ for mathematics exercise. But then again, the strategy ‘note taking’ in maths class was less used by gifted students. Same findings were obtained by Sporer (2003) for relationship between non-verbal IQ and ‘elaboration strategy’ and he also, report negative relationship between IQ and ‘organizational strategy’ use. On the other hand, ‘general reading’ and ‘learning strategies’ found to be vary between gifted and average students based on other variables. Dresel and Haugwitz (2006) report weak negative relationship between IQ level and ‘metacognitive regulation’ in maths problem solving tasks. However, Sporer (2003) again found no relationship between intelligence and ‘metacognition’. Similar result was also repeated in a longitudinal study by Sontag, et al., (2012), they found no relationship between intelligence and the preferences for metacognition. Effect of intelligence on strategy regulation among elementary school students was analysed and found Intelligence have only little role in predicting strategy use when factors such ‘metacognitive attribution’ and ‘knowledge base’ were taken into account (Allexander & Schwanenflugel, 1994; Stoeger & Sontag, 2012).

Intelligence and academic achievement

One of the principal objectives of IQ tests is to predict individual difference in educational outcomes and academic achievement (Spearman, 1904; Ackerman &

Heggsted, 1997). These results are also reported as predictive validity of IQ tests. Studies (Gottfredson, 2005; Jensen, 1998; Neisser et al., 1996; Rolfhus & Ackerman, 1999) reported that general cognitive ability measured by standardised IQ tests predicted Academic achievement (Kaya et al., 2015).

IQ tests based on multidimensional cognitive processing approach to intelligence, like, K-ABC (Kaufman Assessment Battery for Children) and Cognitive Assessment system also predict academic achievement. The study was conducted by Naglieri and Bornstein (2003) and they claimed that relation between intelligence and academic achievement found by these two tests are stronger than correlation obtained by ‘g’ based IQ tests.

In 2003, Luo et al., had attempted to find cause of correlation between intelligence and scholastic performance. They suggest that ‘g’ reflected students potential and academic performance is one of the intellectual activities to which ‘g’ potential can be applied. They reported ‘g’ measured by WISC-R account only for 6% of variability in scholastic performance when cognitive ability measured by MAT was controlled. They suggest mental speed is the cause of correlation between intelligence and scholastic achievement.

Self-regulated learning as a mediator

The role of self-regulated learning as a mediator has been studied in relationship between different variables related to educational outcomes. Some of the main findings are discussed here.

Barnard, et al., (2008) had done studies on online course communication and academic outcomes. They found that online self-regulatory learning behaviours is not strongly associated with academic achievement but do mediate the positive relationship between student perceptions of online course communication and academic achievement.

Son-Mi (2011) investigated relationships among scientific self-efficacy, achievement in science and cognitive self-regulation learning strategy among 158 elementary school students. And found that cognitive self-regulation learning strategy mediated the relation between self-efficacy and achievement in science. Memory learning strategy, considered a cognitive self-regulation learning strategy, did not mediate the relation between self-efficacy and science scores.

Follmer and Sperling (2016) administered direct and indirect measures of executive function, metacognition, and self-regulated learning among 117 undergraduate students attending a large, Mid-Atlantic research university in the United States and proposed a mediation model specifying the relations among the regulatory constructs. In their study multiple linear regression predicted metacognition and SRL and a Separate mediation analyses indicated that metacognition mediated the relationship between executive functioning and self-regulated learning as well as between specific executive functions and self-regulated learning.

Morosanova and Fomina (2017) research on psychological predictors of academic success addresses the problem of self-regulation, anxiety, and the final examination results on the sample of Russian school children (N=231). Main

conclusion for the study was that the conscious self-regulation acts as a mediator of students' anxiety influence on exam results.

A study by Teng and Zhang (2017) found motivational regulation strategies predict English-as-a-foreign-language (EFL) writing performance and this relationship is mediated by Self-regulated learning strategies in a data collected from 512 undergraduate students in mainland China. They specifically mention that only cognitive and metacognitive strategies were found to be significant mediators in the model while social and behaviour strategies were not.

Tian et al., (2018) in order to find out the underlying mechanism of Metacognition, self-efficacy, and motivation and its interaction in self-regulated learning (SRL) of mathematical learning studied 569 students (245 male, Mage = 16.39, SD = 0.63) of Grade 10 in China. Their results suggested that the mathematics performance could be predicted by metacognition, self-efficacy and intrinsic motivation and association between metacognition and mathematics performance was mediated by self-efficacy and intrinsic motivation, as revealed by a multiple mediation analysis.

Lim, et al., (2020) adopted a correlational research design to examine the possibility of relationships between peer learning and online learning satisfaction in the presence of self-regulated learning (SRL) as a mediating variable selecting stratified sample of 347. They found that through Bootstrapping test that the influence of peer learning on online learning satisfaction was fully mediated by SRL.

In the light of careful analysis of previous research findings few summaries can be obtained:

- Self-regulated learning when applied efficiently can have changes in students' academic achievement.
- Self-efficacy has a major role in self-regulated learning strategies and it is the most widely studied construct among self-regulated learning dimensions.
- For, college students (they are cognitively more developed) self- regulated learning strategies differ according to course chosen.
- For younger students' major difference in strategy use is seen mainly in maths.
- Development of motivational, behavioural, cognitive, emotional strategies across age is not well established
- Role of gender in self- regulated learning have to be explored more, especially from an Indian context.
- Effect of different profiles of intelligence (for e.g.; those who are high on visuo spatial, those who are high on vocabulary, etc) on self- regulated learning have to be researched within normal sample group.
- To know the influence of intelligence on Self-regulated learning, researches have been carried out mainly among gifted students and not among normal intellects.
- Do gifted students differ in their self- regulated learning strategy use? - Results are non- conclusive.

- Self-regulated learning act as a mediator between different variables such as communication effectiveness, test anxiety, executive functions, metacognition, motivation, peer learning and academic outcomes.
- All type of research tools- questionnaire, interview, think aloud has their own merits and demerits.

In literature review, more research on mathematic self- regulated learning can be seen than any other subjects. Also, it is observed that maths is a globally accepted ‘difficult to learn’ subject (Dent & Koenka, 2015). Even though more research has taken place in maths, report by Dent & Koenka (2015) found that maths had least correlation with self-regulated learning than any other subjects. Also, most studies which report no significant relationship between academic achievement and self-regulated learning strategies choose maths as specific subject (Malpass et al., 1999).

Because of varying results, a conclusion can’t be obtained about differences in level of self-regulation among students of different IQ level. Inaccurate student self-assessment in questionnaire administered and effects of a social desirability bias could also be the reason. In these studies, learning complexity for each situation are also different. Like, in some studies gifted students were entered into a special programme (Sporer, 2003). Study results were more consistent if the comparison was made on scores obtained in school than between IQ level.

Need and Significance of the Study

The idea of self-regulated learning has become progressively significant in high school education. Contrary to primary school, high school education forces unique stresses on students, as at the end of high school education they must appear for public exam which determine their future. So, school education forces them to be proactive and self-disciplined learners capable of controlling their own learning via self-monitoring and self-evaluation.

Using a sample of 133 high school students and by administering measure of intelligence and by measuring Self-regulated learning through five dimensions, present study attempted to overcome limitation of previous research. (Most of the studies were conducted in college students and among elementary students, and proposed a non-comprehensive model for studying Self-regulated learning- SRL). In order to control for educational and developmental effects the age gap was kept from 13-16 years, who are perusing 9^{th} or 10^{th} standard. The study has been conducted on high school students because they would have developed more cognitive skills and better developed view on learning than primary school students. Passing high school is also seen as a turning point in one's life.

One of the main theoretical implication is that most of the psychological correlates that influence academic achievement is addressed in Self-regulated learning theory (motivation, planning, self-efficacy, time management, procrastinating) (Panadero, 2017). Present study also gives considerable focus on all dimensions of self- regulated learning (motivational regulation, cognitive regulation, behavioural regulation, emotional regulation). This study also has a direct

implication for educational practise, since it implies that student, teachers and parents should focus on child's ability to regulate learning. Also attempt to portray model of self-regulated learning that can be applied as an intervention for students at different educational settings. Thus, this thesis forms one of the first attempts in Kerala educational scenario to promote student learning from an individual centred approach and in a comprehensive perspective.

Based on review of literature, it was found that researchers have demonstrated significant relations among intelligence and academic achievement, self-regulated learning and academic achievement. Effect of different levels of Intelligence on Self-regulated learning have to be researched with in a normal sample group. Mediational role of self-regulated learning has been found in various relationship but its pathway between intelligence and academic achievement is not demonstrated anywhere. So, present study tries to contribute, little more to the research gap, by investigating self-regulated learning of students. Above researches have focused on self-regulated learning mainly from Zimmerman's and Pintrich model. In their multi-dimensional model emotion -regulation of a student in academic setting is not directly addressed or emphasised. While, present study investigates self-regulated learning from motivational, cognitive, meta- cognitive behavioural and emotional dimensions. what role self-regulated learning have on relationship between intelligence and academic achievement is also analysed. Differences in use of self - regulated learning based on demographic variables are also discussed.

Thus, the main objective of this study is to document how self- regulated learning explains the variance in the relationship between intelligence and academic achievement of high school students of Kerala. Based on above objective and previous research, it was hypothesized that, although research on intelligence and self -regulated learning independently predict academic achievement, the relationship between them is expected to be complicated. Thus, objectives of this study were to explore the structure and pattern of different dimensions in self-regulated learning that usually students practise for achieving academic achievement and at examining the manner in which these practices change as function of different levels of Intelligence. For that purpose, a conceptual model was developed by acknowledging that learning is multifaceted Thus, through structural equation model researcher tries to elucidate the pathway of these variables

Statement of the Problem

This study focuses on Self-regulated learning as - motivational, metacognitive, cognitive, behavioural, emotional strategies which are related to educational performance, especially their combined and individual effect on relationship between intelligence and academic achievement. The research also study relation between main variables- intelligence, self-regulated Learning Strategies - SRL and academic achievement. The interaction effect of socio demographic variable and independent variable, with dependent variable is also looked upon. Thus, present study tries to propose a model for self- regulated learning of high school students of Kerala. It is hoped that the findings from this study can offer new insights into the complex interrelationship between intelligence

and student self-regulated learning and academic outcomes. So, the study is entitled as **"The Intricate Relationship Between Intelligence and Academic Achievement: Examining the Role of Student's Self-Regulated Learning Strategies".**

Definition of Key Terms

Intelligence: Ability to utilize 'g' or energy in contextual situations-situations that have content, purpose, form and meaning (Wechsler,1944).

Student: Those who are between the age of 13-16 and attending, 9^{th} or 10^{th} standard of any English medium schools of Kerala which follow Kerala board of education.

Self-regulated learning: Self-regulated learning is a self-directive processes by which learners transform their mental abilities into academic skills (Zimmerman, 2002).

Self-regulated learning strategies: Motivational, cognitive, meta cognitive, behavioural, and emotional strategies practised by students to regulate their learning processes to become a self-regulated learner. Strategies are operationally defined as the way in which students approach learning (or academic challenging tasks).

Motivation regulation: Motivation in academic context can be operationally defined as psychological phenomenon that initiates, guides, and maintains goal-oriented learning behaviours.

Cognitive regulation: Strategies students use to learn lessons or prepare and take exams.

Behaviour regulation: Strategies that are generally observable and represent a concrete behaviour.

Emotion regulation: Negative emotions experienced by student while learning is regulated for successful completion of academic task.

Academic achievement: Here academic achievement refers to scholastic achievement of the students achieved at the end of educational program, designed by test scores.

Research Questions

1. Is there any relationship between the students' self-regulated learning strategies and their academic achievement?
2. Is there any relationship between student's intelligence and academic achievement?
3. What is the relationship between dimensions of self-regulated learning strategies and other variables in the study?
4. What is the role of Socio-economic variables on Academic Achievement?
5. What is the role of self- regulated learning strategies in the relationship between intelligence and academic achievement?
6. What is the pathway of dimensions of self- regulated learning strategies to predict student's academic achievement?
7. What is the pathway of dimensions self-regulated learning strategies in relationship between intelligence and academic achievement?

Objectives

A reading on review of related studies gave basic foundation for entire processes of present research and gave insightful thoughts to formulate objectives and hypotheses. Objectives of the study are:

1. To examine the relation between Intelligence, Self-regulated learning strategies, and Academic achievement.
2. To examine the relationship between intelligence, sub variables of intelligence, academic achievement and dimensions of self-regulated learning strategies.
3. To analyse the role of socio-demographic variables
4. To find out the mediating effect of self-regulated learning strategies on relationship between intelligence and academic achievement.
5. To examine pathways of dimensions of self-regulated learning strategies on academic achievement.
6. To examine pathways of intelligence through dimensions of self-regulated learning on academic achievement.
7. To study the mediating role of dimensions of self-regulated learning strategies on academic achievement.

Hypotheses of the Study

The hypotheses formulated for present research based on objectives described.

Descriptive analysis

1) The sample data are not significantly different than a normal population.

Inferential analysis

2) There will be significant relation among main variables under study.

   2.1) There is a significant relationship between intelligence and academic achievement.

   2.2) There is significant relationship between verbal intelligence and academic achievement.

   2.3) There is significant relationship between performance intelligence and academic achievement.

   2.4) There is a significant relationship between academic achievement and self-regulated learning strategies.

   2.5) There is a significant relationship between intelligence and self-regulated learning strategies.

   2.6) There is significant relationship between verbal intelligence and self-regulated learning strategies.

   2.7) There is significant relationship between performance intelligence and self-regulated learning strategies.

3) There will be significant relation between academic achievement and dimensions of self-regulated learning strategies

   3.1) There is a significant relationship between academic achievement and motivation regulation

3.2) There is a significant relationship between academic achievement and meta-cognition regulation

3.3) There is a significant relationship between academic achievement and cognitive regulation

3.4) There is a significant relationship between academic achievement and behaviour regulation

3.5) There is a significant relationship between academic achievement and emotion regulation.

4) There will be significant relation between intelligence and dimensions of self-regulated learning strategies

4.1) There is a significant relationship between intelligence and motivation regulation

4.2) There is a significant relationship between intelligence and meta-cognition regulation

4.3) There is a significant relationship between intelligence and cognitive regulation.

4.4) There is a significant relationship between intelligence and behaviour regulation.

4.5) There is a significant relationship between intelligence and emotion regulation.

5) There will be significant relation between verbal intelligence and dimensions of self-regulated learning strategies

5.1) There is a significant relationship between verbal intelligence and motivation regulation.

5.2) There is a significant relationship between verbal intelligence and meta-cognition regulation.

5.3) There is a significant relationship between verbal intelligence and cognitive regulation.

5.4) There is a significant relationship between verbal intelligence and behaviour regulation.

5.5) There is a significant relationship between verbal intelligence and emotion regulation.

6) There will be significant relation between performance intelligence and dimensions of self-regulation.

6.1) There is a significant relationship between performance intelligence and motivation regulation.

6.2) There is a significant relationship between performance intelligence and meta-cognition regulation.

6.3) There is a significant relationship between performance intelligence and cognitive regulation.

6.4) There is a significant relationship between performance intelligence and behaviour regulation.

6.5) There is a significant relationship between performance intelligence and emotion regulation.

7) There will be significant inter correlation between overall self-regulated learning strategies and dimensions of self-regulated learning strategies

   7.1) There is a significant relationship between overall self-regulated learning strategies and motivation regulation

   7.2) There is a significant relationship between overall self-regulated learning strategies and meta-cognition regulation

   7.3) There is a significant relationship between overall self-regulated learning strategies and cognitive regulation

   7.4) There is a significant relationship between overall self-regulated learning strategies and behaviour regulation

   7.5) There is a significant relationship between overall self-regulated learning strategies and emotion regulation.

8) There will be significant interaction between three levels of self-regulated learning strategies and sex on academic achievement.

9) There will be significant interaction between three levels of self-regulated learning strategies and class of studying on academic achievement.

Mediator analysis

10) Self-regulated learning strategies shall mediate the relationship between intelligence and academic achievement.

Path model for academic achievement, following hypotheses was proposed.

11) Dimensions of self-regulated learning strategies will have direct effect upon academic achievement.

12) The effect of intelligence on academic achievement will be mediated by dimensions Self-regulated learning strategies.

Research Processes

One of the common and general thought about academic achievement is that ‘a high achieving student is highly intelligent’. One of the common issues shared by students is “why can’t I score good grades despite my effort?”. These aspects were always concern and interest of researchers and psychologists or mental health professionals. So, researcher wanted to further explore on the topic of academic achievement. These thoughts were articulated to research problem as follows

- Are high achieving students always highly intelligent?
- How can one become a competent learner?

From these board problems, research question was formed and based on it, objectives were formulated. It was decided that a quantitative research approach can be followed. A thorough reading on the concept of intelligence prompted more and more research questions and one of the main questions was the debatable age-old question “what is intelligence?’’ and “what are the specific cultural elements that are incorporated to concept of intelligence specific to Kerala culture?”. A small attempt was made to enquire about the same and published as an article- ‘Analysis of

Theories of Intelligence: Emerging Themes' and a paper is presented as 'Special Educator's Personal Conceptions of Intelligence'- Kerala Context'.

Further readings on how to become a competent learner ended in agreeing with concept of self-regulated learning. The vacuum of comprehensive research studies in India, specifically to Kerala context, stressed the importance for carrying out an exploration of learning strategies applied by students in a Kerala educational context. Thus, exploration was done along with development of a tool. A tool for exploring self-regulated learning strategies was constructed and standardised among high school students of Kerala who attend schools which follow Kerala board of syllabus (English medium).

Researchers always shown interest in exploring the role of self-regulated learning in relationship between other personal or family or situational variables and academic achievement. Here, researcher was interested in exploring the role of self-regulated learning in relationship between intelligence and academic achievement. It was decided that intelligence could be measured using- Malin's Intelligence scale for Indian Children. (MISIC). English medium was selected because it was observed in the manual that MISIC was standardised for English speaking individuals. Only students who follow Kerala board of education were selected. Academic achievement was obtained by collecting half yearly exam results from school records. After data collection, respective analysis was carried out.

During administration of MISIC and during data analysis some common atypical pattern were identified in response verbatim of samples, which lead to the query that is MISIC properly standardised for present population of Kerala. So,

further study was done to explore more about standardisation issues in MISIC. While standardising tool for measuring self-regulated learning strategy -SRLS it was found that Exploratory Factor analysis - EFA, does not fit theory. During pre-submission it was recommended that standardisation issues of self-regulated learning strategy – tool had to be found out. Professors made strong arguments for reporting EFA of the tool and also to conduct second order confirmatory factor analysis of the same. The committee also suggested to explore the possibility of Exam score as a measure of academic achievement. They also recommended to discuss briefly all the above as a heading 'general observation' at the end of result and discussion.

As a background for the research few studies were carried out and published as a book chapter – 'Revitalizing Intellectual Assessment of Kerala' and journal article on 'Present Status of Intelligence of Testing: A Critical Analysis WAIS, WAPIS and MISIC'. A paper was also presented with title, 'Need for Cultural Contextualization of Vineland Social Maturity Scale: A Critique' – which discuss the differences that occurred in norms mainly due to generation gap.

Chapter 2

Method

- **Philosophy of Research**
- **Research Design**
- **Participants**
- **Instruments**
- **Administration**
- **Statistical Analysis Techniques**

This chapter outlines the research methodology that guided present research. It includes paradigm of research, the design, data collection method, measurement method and analysis techniques used. Observations and experiences of researcher during the research processes, especially insights formed during data collection and analysis stage is briefly reported in general observation section (pg 158).

Research Perspective

Deciding of particular perspective or approach is based on the purpose of research. The purpose of present research was to empirically test the assumption that self-regulated learning strategies plays a significant role in the relationship between intelligence and academic achievement. As the issue being addressed was about academic achievement (mainly scores or grades obtained in exams), the research problem was sorted out by collecting data quantitatively on instruments by assuming quantitative hypothesis. Thus, the objective of present research justified the use of a quantitative approach. “Quantitative research is an approach for testing objective theories by examining the relationship among variables which can be measured (on instruments) and resulting data in numbers can be analysed using statistical procedures, which help for generalization and replication” (Creswell, 2014). It was also influenced by the view that intelligence can be measured and are quantifiable (acknowledging the on-going debate on IQ testing). Also, at the same time on the assumption that student’s use particular strategies for learning and researcher intended to understand and measure the frequency of those strategies that may lead to self-regulated learning. Within this quantitative approach, present research adopted on post positivistic paradigm position.

During 20th century there was a shift from positivism to post positivism in psychological research- which acknowledges that all observations can be fallible and can have error and all theory is revisable. So, this paradigm sticks on to probabilities, multiple measurements. There is a reality external to person's belief system which cannot be measured with certainty and if a hypothesis is rejected, it doesn't mean that the result obtained is certainly the 'truth' about reality, Whereas the results may get rejected due to any other number of factors. As a contemporary paradigm, post positivist research strives for objectivity and neutrality focusing on prediction and explanation (Phillips & Burbules, 2000). In this research a post positivistic position was taken (no absolute truth of knowledge). The investigator began with a conjecture – that, self -regulated learning strategies plays a role in the relationship between intelligence and academic achievement and then collected data to test the hypothesis of predictions on outcome variable, i.e. Academic achievement, so that it can be either supported or disproved. All in all, this research seeks to develop a true statement that describes the causal relationship between Intelligence, Self-regulated learning strategies and Academic achievement variables. Being objective by recognising possible effect of bias was an essential aspect of this research, so method and conclusion was examined for bias by setting standard of validity and reliability.

Conceptual components that define Post-Positivistic paradigm of present research was ascertained through ontology (nature of reality,) of critical realism- reality exists but imperfectly known. Meaning is made from data gathered, but objectivity of data gathered is questioned. There can be bias and finding can be

‘probably true’. Epistemology (nature of knowledge) follow a modified objectivity, i.e. conclusion obtained from preliminary supporting evidence which is suspected to be true (but for which no proof of disapproval is found yet) are tested. Findings obtained from present research approximate the truth but reality cannot be fully explained. Present research takes an axiological position in midpoint of the continuum of ‘value free’ to ‘value laden’, i.e. enquiry involves values but they are controlled though different steps – standardising questionnaire, establishing reliability and validity, testing for normality and significance is tested using statistical analysis. This research takes a quantitative methodological position (the method used to know the unknown).

Research Design

Within this quantitative method correlational research design was selected. Correlational design involves collecting data of specific population (here, high school students) and ascertaining relationship among variables of interest, for present research it was relationship among intelligence (IQ), self- regulated learning strategies (SRLS) and academic achievement. Students are not randomly assigned to any groups nor are the independent variable manipulated. Here, emphasis was placed in determining how intelligence -IQ (I.V) is related to Self-regulated learning strategies (SRLS) and academic achievement (D.V).

Research Method

Method formulated is explained further through four sections.

Section 1: Participants

Section 2: Instruments

Section 3: Data Collection

Section 4: Statistical Analysis Techniques

Section 1: Participants

In this section population of present research is defined and sampling technique is explained. For present research, population composes of all students of age 13 years and 1 month to 15 years and 11 months (the age was specified based on class of study and based on age group specified in intelligence test administered), who attend ninth or tenth standards of government or aided schools, which follow Kerala English medium syllabus. Ninth and tenth standard syllabus follow same subject pattern. Also, students of this age group are comparatively more cognitively developed to reflect on their own learning processes.

Sampling technique

As it is not feasible to study population as a whole, a workable number of students were selected based on the objective of the study. Students were selected through simple random sampling. A total of 150 participants were selected, 11 students couldn't complete administration, 2 participants became outliers, 4 samples had missing information on academic achievement measure. Thus, 133 samples remained for present research.

Sample characteristics

From Table 2 it is seen that majority of participants were females, 60.2% and only 39.8% were males. Fourteen year age group had a greater number of participants 69.9%, 16.5% belonged to 13-year age group, and 13.5% belonged to 15-year age group. Most of the students were attending 10^{th} standard, 65.7% and 34.3 % of students attended 9^{th} standard. Parent's profession was classified as unskilled, skilled and professional. Unskilled refers to labour which do not require any specific skill or training. Skilled refers to labours which require specific knowledge, ability, or training and have income on hourly or work requirement basis. Professional refers to labour which require a college degree or above and have income on monthly basis. Table 2 also shows 22% of student's parents were unskilled labourers, 46 % were skilled and 65 % of students' parents were professional. Based on place of student's residence 29.8% lived in urban area and 69.4 % lived in rural area. Here, Rural refers to place under revenue villages and Urban refers to place under municipality or cooperation governance.

Table 2

Demographic Characteristics of Present Sample

Demographic variable	Category	No of students n	Percentage of students %
Sex	Male	53	39.8
	Female	80	60.2
Age	13	22	16.5
	14	93	69.9
	15	18	13.5
Class attending	9^{th}	45	34.3
	10^{th}	88	65.7
Parents profession	Un-skilled	22	16.4
	Skilled	46	34.2
	Professional	65	48.5
Place of residence	Urban	40	29.8
	Rural	93	69.4

Section 2: Instruments

Measures used for data collection are described in this section with respective psychometric properties. They are

- MISIC – Malin's Intelligence scale for Indian Children
- SRLS – Self-Regulated Learning Strategy
- Academic Score sheet
- Socio demographic data sheet

Malin's Intelligence Scale for Indian Children (MISIC)

MISC is an intelligence test adapted and standardised by Dr Arthur J. Malin for English speaking children in India of age group 6 to 15 years and 11 months (also developed in other languages like Hindi and Marathi). The test is adapted from WISC (Wechsler intelligence scale for children) developed originally by Dr David Wechsler. According to Wechsler (1944) intelligence is "Ability to utilize 'g' or mental energy in contextual situations-situations that have content, purpose, form and meaning". All items of a subtest are arranged in the increasing order of difficulty. The WISIC consist of 12 subtests but in MISIC there is only 11 subtests. Picture arrangement test is not included due to cultural specificity. The subtests are as follows:

- Verbal scale – Information, Comprehension, Arithmetic, Similarity, Vocabulary & Digit Span.
- Performance scale - Picture Completion, Block Design, Object Assembly, Coding, Mazes.

***Standardization statistics*.** Full test was administered to over 1200 children in a time of 6 years. 90 participants were included in each age level with male to female ratio 20:30. Samples were taken from Hill boarding schools of Nagpur, Bombay, Shimla, Mangalore, New Delhi. Percentile points are converted to IQ based on modified Thomson formula with standard deviation 15.

***Psychometric properties*.**

Reliability- Test retest reliability is 0.91 for full-scale IQ result.

Validity- Concurrent validity was established with school academic record and convergent validity with adapted version of California short-form test of Mental Maturity for the upper age level and from the good enough Draw a Man test for the lower age level yielded a coefficient of 0.63.

Self-Regulated Learning Strategy (SRLS)

Self-regulated learning strategy is an inventory and was developed by investigators. It has 42 statements that describe the strategies students may use in a typical learning situation. These statements are grouped into five dimensions, based on theoretical model of Zimmerman's (1986) socio cognitive model, motivation centred model (Pintrich & Groot, 1990) and Boekaert's (2011) emotional regulation model. Dimensions are motivational regulation, cognitive regulation, meta-cognitive regulation, emotional regulation and behavioural regulation. It is a 5- point Likert scale anchored by Never, Seldom, Sometimes, Often, Always. It can be administered in group or for an individual student. The instrument was developed in English language, as the intended sample group was students has who been following English Medium education.

Psychometric properties. Cronbach's alpha for Overall scale had reliability coefficient of 0.91. The dimensions were significantly correlated with each other ($r = 0.47–0.66$, $p < .01$). Detailed description of the test, construction of test, definitions of dimensions, psychometric properties of the test are presented in chapter III. Copy of final form of Self-regulated learning strategy is appended as appendix E.

Academic Achievement Score Sheet

For academic achievement variable it was decided that Average Exam scores can be taken. York et al., (2015) have described academic achievement and ways to measure it as follows,

> Academic achievement is representation of academic ability and measures students' performance ability. In that sense scores obtained in exams measure attainment of learning objectives and acquisition of knowledge. In literature it is seen that Academic achievement is almost entirely measured with grades (by course or assignment) and GPA and represented in an aggregate form (grade in a course or GPA or scores) this is unsurprising since grades and GPA measures are by far the most readily available. (York et al., 2015)

Only few research studies prepare separate assessment questions for each course subject. Such a measure was difficult to develop as different experts in respective fields have to be approached for question preparation and scoring. So, it was decided that scores on upcoming exam can be regarded as a measure of academic achievement.

Academic achievement score sheet was prepared for each student based on the score obtained from the promotional list of respective school and class. As, 10^{th} standard annual exam is a public exam and scores are not available (only grades are printed on mark sheet), half yearly exam scores were collected for both classes. Academic achievement score sheet is appended as appendix F.

Personal Data Sheet

Personal data sheet is used to collect relevant demographic information such as age, class, sex, parent's occupation, place of residence and birth order of participants in the research. A copy of sheet is appended as appendix B

Section 3: Data Collection

Procedure and administration

For data collection a prior consent was obtained from headmasters of schools after explaining about the topic, significance of the study and implications of the research. A distraction free room was requested and most school provided a separate room. A detailed description about the study was explained to the whole batch of 9^{th} and 10^{th} classes. Description given to students was briefly described in informed consent form. (Informed consent form is appended). Students were informed that the study was not part of academic syllabus and participation was voluntary and confidentially was asserted. A list of 180 students were obtained who were willing to participate, from that list 150 samples were randomly selected. Among them complete administration was made possible for 139 students.

Administration was conducted individually to each student. Before starting administration, an informed consent describing study in brief, statement of withdrawal at any time, statement that parents and students understood the study purpose was obtained. It took almost 1.30 -2 hours for administration. It was difficult to make students complete administration because of the time taken. Most schools couldn't provide a distraction free room and also some schools weren't

willing to provide promotional lists, so such schools couldn't be included in the study. Natural disaster such as flood, Nipa virus out break and other contagious illness made schools closed for weeks. So, all classes were behind the allotted time schedule to finish syllabus, and some teachers weren't willing to allow their students to participate. Due to these constraints and as it was required that data must be collected in one academic year, only 139 data was obtained. From that data set, 4 data were deleted as response sheet was incomplete for academic achievement and 2 data set became outliers. Finally, 133 data were obtained.

A distraction free room was allotted for administration. At first, a pre-specified two-hour appointment was taken for 2 students/ day. One student in the morning section (10am – 12 pm) and another student in the evening section (1.30 pm – 3.30 pm). Students freely choose their preferred day and time.

After making students at ease, they were briefed about the whole study "This is a study to understand what are the self-regulated learning strategies you use for learning academic tasks and what role it plays in relationship between intelligence and academic achievement. For that purpose, an IQ test will be administered which can take 1-2 hours, to fill up a form of self-regulated learning and providing some personal details. Some of the academic details especially the scores of next half yearly exam would be collected from your respective class teacher. Taking part in this study is not compulsory and will not affect any of your academic works. If you feel uneasy, you can withdraw at any time. I will take all the efforts to maintain confidentially of your responses and especially your identity as a participant." Then they were asked to fill up the personal data sheet. MISIC was administered as per

instructions in the manual. Even though Self-Regulated Learning Strategy -SRLS have instructions printed on, investigator gave a clear instruction on ‘how to fill and put tick mark in respective columns.’ The participants were free to ask any doubts related to the study. Later on, academic scores were collected from promotional list by getting permission from respective class teachers.

Scoring

Malin’s Intelligence Scale for Indian Children (MISIC). The raw score obtained for each subtest is converted to corresponding test quotients (TQs) by means of the T table in the manual and then averaged to get verbal IQ and Performance IQ which are then converted to full scale IQ.

Self-Regulated Learning Strategy (SRLS). Items are scored 0, 1, 2, 3, and 4 respectively for responses never, seldom, sometimes, often, always. The dimensions are motivation regulation, meta cognitive regulation, cognitive regulation, behaviour regulation, and emotion regulation. Total score for each dimension can be obtained by adding scores of respective items. Total score of 5 dimensions can be summed up to get a total score on SRLS. The score can range from 0- 210. Higher score indicate that students use more strategies for regulating their learning processes than a low scorer.

Dimension related items

Motivation regulation: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Metacognitive regulation: 11, 12, 13, 14, 15, 16, 17

Cognitive regulation: 26, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42

Emotional regulation: 25, 27, 28, 29, 30, 31

Behaviour regulation: 18, 19, 20, 21, 22, 23, 24

Consolidation of data obtained

After scoring Intelligence test and self-regulated learning strategy, the Personal and family back ground information collected from participants were coded and also the raw score of each student was entered to Excel Spread sheet. SPSS (The statistical Package for social science) V20 was utilised. Then, descriptive analysis and inferential analysis were carried out using SPSS Software. Respective analysis was carried out based on hypothesis formulated. SPSS V20 comes with a free downloadable pre- programmed bootstrap extension to analyse mediation and moderation. In order to find path coefficients between variables and to draw respective path diagrams AMOS V22 software was used.

Section 4: Statistical Analysis Techniques

In order to obtain inferences and make generalisations the obtained data was analysed by estimating parameters based on sample statistics. The main purpose of the present research was to test the tenability of hypothesis and formulate a model. Descriptive analysis helped to understand data quantitatively, for that purpose, measures of central tendency, dispersion, Skewness and Kurtosis was found. Normality was tested. Inferential analysis helps to form inferences and thus relationship between variables were established. Inferential Statistics was performed in order to make conclusions and answer research questions and thus hypothesis was tested using different statistical technique. Thus, statistical technique used were:

- ANOVA
- Correlation analysis
- Mediation analysis
- Pathway analysis

Analysis of variance – ANOVA

Properties of variables based on socio demographic variables were found out using ANOVA**.** Through this statistical model differences between more than two groups were found. The three steps in analysis are, sum of squares for all samples, with in class and between class. Based on number of main effects and interaction effects, analysis can be one way, two way.

Correlation analysis

Correlational analysis describes the degree to which two variables, the independent variable and dependent variable, are related. Correlation coefficient can take up any value between +1 and -1. Zero value of correlation coefficient indicate no relationship, '1' indicate perfect relationship. The signs indicate the direction of relationship. Positive sign indicate that variables move in same direction, i.e., if one increases the other variable also increases, if one decreases the other variable also decreases. The negative sign indicates variable moves in opposite direction. Karl Pearson product moment correlation was used to find relationship between variables - intelligence, self-regulated learning strategies, sub variables and academic achievement.

Mediation analysis

In order to infer the role of Self-Regulation Learning Strategies in relationship between intelligence and academic achievement, mediation analysis was carried out using Processes Macro V3.4. It makes use of 4 steps of multiple regressions specified by Baron and Kanny (1986). In order to test significance of indirect effect, Bootstrap confidence interval was found.

Path analysis

Path analysis is a multi-dimensional analysis technique used to analyse relationship between variables and allows for multiple independent variables. Generally, it is considered as extension of multiple regression. It is theoretically guided analysis and forces the researcher to specify relationship (indirect or direct) between independent and dependent variables. Two prerequisites are that (a) all pathways must go in one direction and variable must have clear time ordering. The path analysis is a special case of Structural Equation Modelling (SEM).

As there have been a large increase in SEMs in behavioural science, it is observed that most of them for considering sample size relay on rules of thumb. As path analysis and SEM is a complicated and sophisticated technique it requires large sample size. But “how large is that large”? The most common general rule of thumb is that sample size >200 is required. For present research, sample size was 133. Determining appropriate sample size for path analysis is a critical issue. There is no consensus in literature regarding appropriate sample size. A minimum sample size of 200 and 10 or 20 observations per indicators are the generally accepted rule of

thumb. Bentler and Chou (1987) report that if data is normally distributed and if latent variable have multiple indicator with adequate factor loading, then a ratio of 5 cases per number of free parameters is enough, but a ratio of 10:1 would be more appropriate. Wang and Wang (2020) also report N =100-150 is a minimum sample size. In, mediation models, models can achieve adequate statistical power for direct and indirect effects with smaller sample size, if indirect effects have moderate effect on dependent variable. Klien (2011) recommend that 10 cases for every parameter is necessary. Number of Parameters that estimated for path analysis include number of paths, the number of curved arrows, the number of exogenous variables, and number of disturbance terms. For present research the number of parameters range from 16-22 In mediation model increase in sample size of single indicator models could not account for biases in result, but it was related to unspecified reliability. i.e., A measure of 90% reliability can estimate a direct path parameter with around only 10% bias, as the reliability of measure decreases, bias can increase. For present research Self-regulated learning strategies and intelligence have reliability around 0.9. Cole and Maxwell (2003) report that their study demonstrated to behavioural researchers that there is broad variability in sample size requirement for latent variable models and showed sample size estimate vary greatly from model to model. But usually N<100 is considered small sample and N =100-150 is considered medium sample size and N≥200 is considered large and “One Size Fits All Approach” doesn’t seem to work out (MacCallum et al., 1999). So, it is assumed that based on rule of thumb a ratio of 5 cases per number of free parameters proposed by Bentler and Chou (1987), present research have adequate number of sample size.

Path analysis was carried out for different models by using AMOS V.22, thus attempting to answer the question of direct and indirect relationship between variable intelligence as independent variable, dimensions of self-regulated learning strategies as mediators and academic achievement as dependent variable. Input models were modified and then selected based on model fit.

Chapter 3

Test Development

- **Self-regulated learning strategy**

For present study, investigator developed a test of Self-regulated learning strategy. Item writing, analysis and standardization of self-regulated learning strategies inventory is presented in this chapter.

Self-Regulated Learning

Basic concepts of Self-regulated learning stems from psychological theory of self-regulation. Self-regulation can be defined as one's ability to consciously control, guide and manage ones thought and behaviour. Albert Bandura was one of the pioneering cognitive psychologists who contributed to self-regulation theory by focusing on researches on acquisition of behaviour, which lead to integration of behavioural, cognitive and social components of regulation. These researches finally lead to development of social cognitive theory and social learning theory. He concludes that, self-regulation is a multifaceted phenomenon which includes cognitive processes of self-monitoring, evaluative self-judgement, self-appraisal and affective self-reaction (Bandura, 1991). This theory integrates behavioural, cognitive, environmental and other personal variables to explain how human beings' function.

During the late 20th century Zimmerman and Shunck (1989) tried to integrate Bandura's self-regulation theory to academic learning and educational setting. Based on his researches, Zimmerman proposed an initial Model of Self-regulated learning theory and defined it as "Self-Regulated Learning - In general, students can be described as self-regulated to the degree that they are Metacognitively, Motivationally, and Behaviourally active participants in their own learning process…. To qualify specifically as self-regulated in my account, student's learning

must involve the use of specified strategies to achieve academic goals on the basis of self-efficacy perceptions" (Zimmerman, 1989).

At present theoretical and experimental research on self-regulated learning is varied where, each theorist tries to explain self-regulated learning from their own perspective. Research is still going on and the concept is still in the evolution phase where final integrated comprehensive view is not fully developed. But all theories have their origin from works of Zimmerman. All theorists agree that Self-regulated learners are students who control their motivation, cognition, behaviour and emotions and try to become active participants in their own learning processes. Particularly, they are motivated to achieve their academic goal, are aware of their own academic strength and weakness and use specific strategies to improve their learning experiences and overcome their academic challenges and thus become successful in academic setting.

Operational definition

Based on theoretical literature review, present research operationally defines *self-regulated learning strategies* as 'Motivational, cognitive, meta cognitive, behavioural, and emotional strategies practised by students to regulate their learning processes to become a self-regulated learner'. Strategies are operationally defined as the way in which students approach learning (or academic challenging tasks), i.e, actions and processes oriented towards knowledge or skill acquisition that would be purposeful and instrumental in nature. Instrumental in the sense strategic actions are performed to reach a goal.

Why measuring self-regulated learning is important?

An instrument measuring self- regulated learning strategies can identify student's strength and weakness with respect to regulation of their own learning practice. This information could be used to help students learn more effectively, either reflecting to their own responses to self-regulated learning strategy inventory or by discussing with professionals. In either way students get awareness about their own learning methods. They can start performing strategies they don't practise or they can repeat confidently what they already perform. Thus, by inventing themselves students can improve their academic learning experiences, there- by improving academic achievement. So, it was also decided that self-regulated learning strategies of students can be measured through a self-report inventory.

The need for a new measure

Instruments presented in literature which measure self- regulated learning either focus more on one particular perspective, for e.g., The Motivated Strategies for Learning Questionnaire (MSLQ) focus more on cognitive learning strategies and motivational variables than on emotional variable (Pintrich et al., 1993) or some measures define self-regulated learning as occurring in different phases than as a specific strategy, for e.g., Self-regulated online learning questionnaire was developed based on three phases; Preparatory phase, Performance phase, Appraisal phase (Jansen et al.,2017). Instruments like The Learning and Strategies Study Inventory (LASSI) were developed for university students (González-Torre et al., 2008). In some measures self-regulated learning was defined as an event rather than as an aptitude, for e.g., Think aloud protocol. All instruments were developed for

non-Kerala educational context. For present study investigator was in need of an instrument which operationally define Self- regulated learning as strategies used for learning defined as motivation regulation learning strategies, meta cognitive regulation learning strategies, cognitive regulation learning strategies, behaviour regulation learning strategies and emotion regulation learning strategies. These five dimensions should be applicable to high school students of Kerala. So, it was decided that developing a new measure would be appropriate.

Development of an inventory for measuring self- regulated learning strategy

For developing a reliable and valid psychological test for measuring self-regulated learning strategies,7 steps were followed (DeVellis, 1991).

1. Determining clearly the concept of self-regulated learning strategy

Self-regulation is a general psychological phenomenon that concern about individual's ability to regulate their behaviour towards a desired goal. Based on Zimmerman's (1989) conviction, here, self-regulated learning is defined in terms of strategies. i.e. to be certified as a self-regulated learner must involve the use of specific strategies to achieve academic goal. Items of self -regulated learning strategy inventory was developed specifically to measure frequency of strategies performed by high school students in their learning situation. Thus, specificity was established in - three domains i.e. in content, population and setting.

Self-regulated learning strategies inventory presupposes that students are capable of understanding the meaning and content of each item. It also requires a minimum level of declarative and procedural knowledge. Review suggests that self-

regulated learning is a specific process rather than a general process that may present only during academic learning. Content of self-regulated learning strategy inventory was determined based on substantive theories so far discussed. Conceptual formulations were determined as follows.

Motivation regulation. Motivation in academic context can be operationally defined as psychological phenomenon that initiates, guides, and maintains goal-oriented learning behaviours. Students who are motivation regulated use strategies such as self- efficacy belief - (Student's belief that they have the capability to learn and complete successfully or perform better in their academic work, Goal orientation – (why do students set their goals? - is it intrinsic or extrinsic motivation), Task value belief – (What is the benefit in setting this goal? -student's perception about importance of task, interest in task, and value of task).

Metacognitive regulation. Metacognition was operationally defined as student's awareness and knowledge about tasks related to learning, use of strategies related to learning and cognitive processes related to learning. Strategies include Self-monitoring or self-evaluation – (students compare academic task they perform against criteria that they used to assess it). Planning and goal setting – (thinking of steps to be taken while learning or performing a task and setting one's desired goal for that task.) Regulation – (monitoring processes sometimes suggest need for regulation to bring back behaviour in line with goal).

Cognitive regulation. Strategies students use to learn lessons or prepare and take exams. It includes strategies such as, Rehearsal – (these strategies help students to attend to and select important information from text. It helps to keep information

in working memory), Elaboration – (involve paraphrasing or summarizing and creating organised notes thus connecting and relating concepts that helps for very deep level of processing), Organisation – (involve selecting main idea, outline the text, making graphical representation of text), Peer learning and Reviewing.

Behaviour regulation. Strategies that are generally observable and represent a concrete behaviour are used to regulate and control learning, e.g., self-recording, time management, environment setting, help seeking, etc.

Emotion regulation. Negative emotions experienced by student while learning is regulated for successful completion of task. It includes Test Anxiety Regulation and Effort Regulation.

Integrating different dimensions as the concept of self-regulated learning. Self-regulation is the processes of monitoring, regulating and balancing an optimal level, and when it comes to learning academic tasks, it is just as essential as to our existence. For maintaining an optimal level regulating emotion is also essential. Dimension such as - Motivation regulation, Meta cognitive regulation and Behaviour regulation was conceptualised based on Zimmerman (1989) definition of self-regulated learning and also based on Pintrich et.al., (1991) conceptual framework of Motivational and learning strategies. Ben-Eliyahu and Linnenbrink-Garcia, (2015) proposed integrated model on emotion, cognition and behaviour was also referred.

So, broadly speaking self-regulation includes regulating cognition, meta-cognition, behaviour, emotion and motivation related to learning. While regulating

learning these dimensions are interlinked and determine academic achievement and, in present research, an integrative model of self-regulated learning was proposed.

2. *Generating item pool for five dimensions of self-regulated learning strategies*

With specific measurement goal in mind, investigator described the items clearly as possible in order to capture exact content of item. *Redundancy* was established to capture the exact construct by attempting to capture the phenomenon of interest by developing set of items that reveal each domain in different ways. *Number of items* was restricted to 68 in initial draft as a large pool of items will be difficult to administer on a single occasion to a group of high school students. Exceptionally *lengthy items* were avoided and *reading difficulty* level was chosen keeping in mind a high school student. *Doubled barrelled* items (items referring to two or more ideas) and *ambiguous items* were not included. As the target population was high school students, *reversals in item polarity* may create confusion. So, items were framed generally based on the assumption that the student performs specific strategy and only a few negative worded items were included when the presence of a psychological phenomenon indicate lack of strategy use. Items were written in English. The intended sample group was English medium high school students. They are students who communicate, listen to and write English as their medium of Education.

For generating item pool different theoretical perspectives were followed. Each item was written by specific perspective in mind. Zimmerman had validated 14 strategies that can be used as an interview protocol while assessing self-regulated learning of high school students. Some of the items in present tool were formed

based on some of these 14 strategies. They are (Zimmerman, & Martinez-Pons, 1986):

- Self-evaluation— statements that indicate student-initiated evaluation of quality or progress of their work (Meta Cognitive Regulation)

  20. I often ask questions to myself in order to make sure I understand it.

  22. I ask myself questions in order to check whether I understood what I have learned.

  28. I usually checks whether I understood what teacher took in class.

  27. I often pause myself while reading in order to check whether I understand it or not.

- Organisation - Student initiated overt or covert rearrangement of learning material to improve learning (Cognitive Regulation)

  54. Based on lesson parts I make simple charts, diagrams or tables to help me organize my thoughts.

  56.I create my own examples to make lessons more meaningful.

  67.I underline or highlight important points in lessons.

- Goal setting and planning - Statements indicating students setting educational goal and sub goals and planning for sequencing, timing, and completing activities related to goal (Metacognitive regulation)

  18. *Before I study new chapter thoroughly, I often skim pages to see the contents.*
  19. *I try to think and decide on which chapter I should learn rather than just reading any chapter*

- Seeking information - Statements that indicate student initiate to make effort to learn further about learning information from non-social resources. (Cognitive Regulation)

  58. When I study, I collect more information from other sources (library/internet, etc)

- Environmental structuring – Statements that indicate Students initiate to select or rearrange physical setting to learn more easily. (Behavioural Regulation)

  31. I have a specific place at home for learning

  32. I Often seek quite places for studying and if I can't find one, I make sure I don't get distracted.

- Rehearsing and memorising – Statements indicating Student initiated effort to memorise learning material by overt or covert practise. (Cognitive Regulation)

  42.I make my own questions and try to find out answers to them

  64. When I study, I practice saying lesson parts/questions and answers to myself.

  65. When I study, I go through lessons and class notes and tries to find most important ideas in order to memorise those.

  66. I memorize keywords to remind some important lessons parts.

  68. I usually read text books

- Seeking social assistance- Statement indicating Student initiate effort to get help from peers or teachers (Behaviour regulation).

  35. When I can't understand lessons. I seek help from another student

  34. I ask my teacher to clarify any lessons I don't understand well

- Review notes – Statement indicating Student initiated effort to review notes or texts or textbooks (Cognitive regulation).

61. I usually review class notes/textbooks after class

55. I review notes before next class.

In order to write items Pintrich et al., (1991) theoretical framework on general cognitive view on motivation and learning strategies was also followed. Few of the items were adapted. Some of these are (Pintrich et al., 1991):

- Intrinsic goal orientation- Statement indicating student-initiated effort to participate in learning processes for reasons such as curiosity, mastery or challenge. (Motivation regulation)

  3. I want to get highest grade/mark in the class so I learn

  5. I study hard to get good scores/grades.

  8. I study hard to score higher than some particular friends

  11. I study hard to satisfy my teachers concern.

  12.I study hard to satisfy my family.

- Extrinsic goal orientation- Statement indicating student-initiated effort to participate in learning processes for reasons such as grades, rewards, performances, evaluation by others and competition. (Motivation regulation)

  9.Whichever subject I learn I try to understand it deeply.

  10. I learn from mistakes I makes in my school work.

- Task Value- Statement indicating Students evaluation of how interesting, how important, how useful the task is. But goal orientation refers to reasons why a student is performing the task and task value refers to what do student think of this task. (Motivation regulation)

  2. *I am interested in studying.*

  6. I believe learning is important for my future.

  15. I believe learning will help for my personal growth.

  16. What I learn in this class is important for me.

  17. I believe what I learn in this class will be useful for my higher studies

- Self-efficacy beliefs- Statement indicating students' judgement of one's ability to master the task and confidence in one's skills to perform that task. (Motivation Regulation)

  1. I am confident that I can score good marks/grades.

  4. I believe I can understand most difficult lesson parts.

  7. I can do well in assignments/projects.

  13. I can solve a problem if I keep working on it.

  14. I am good at my school works.

- Test Anxiety Regulation -Emotional and Cognitive component related to test anxiety will have negative influence on task performance. Statements indicating student's effort successfully regulating negative thoughts. (Emotion Regulation)

  44. I panic during exams and cannot completely answer all questions.

  45. Due to anxiety I can't concentrate while studying on the eve of exam.

  46.I won't get discouraged if I get low grade and will try hard to score more in upcoming exams.

  47.In-order to reduce my anxiety during exams, I think how relaxed I will be when these exams are over.

  48.If I feel anxious in taking exam, I tell myself 'you can do it'.

  49.When exam nears, in order to decrease exam anxiety, I meditate.

- Elaboration – statements indicating students' effort to store information in long term memory (cognitive regulation)

  41. In order to learn difficult lesson parts (essay questions and answers) I write summary.

  59.I try to relate lessons in one subject to another subject whenever possible.

  60.I try to relate new lessons to what I have already learned and know

  62.I compare my answers/class notes with other's notes.

- Monitoring - statement indicating student's effort to track attention while reading, self-testing, questioning. Similar to self-evaluation (Metacognitive regulation)

- *I allow my mind to wander during class or learning*

- Regulation- statement indicating students' continuous effort to adjust cognitive activities by checking and correcting behaviour as they proceed (Metacognitive regulation).

  1. When I read if I get confused, I usually refer to it.

  24.If reading a lesson become difficult, I change the way I learn (e.g.: - reading slowly, writing, etc.

  25.I lose marks or grades because of misunderstanding.

  26.I slow down reading when lessons become difficult.

  30.During exams I skip difficult questions and then return to it after writing easy questions.

57. If I don't understand a sentence, I try to understand its meaning from surrounding sentence.

- Peer learning- Statement indicating student's effort to collaborate with peers help them to develop insight (Cognitive regulation)

  63.I teach lessons to my friends.

- Effort Regulation- statement indicating students' effort to regulate negative emotions due to uninterested task and distraction. (Emotion Regulation)

  39.Even if some lessons are boring, I keep learning until I finish.

  50.When I get bored during study time, I think about the importance of learning.

  51.When I go backward in learning activities, I remember about my focus.

  52.When bored I change my study place.

  53.If I fail, I lose interest in learning.

Time Management -statement indicating students' efforts to scheduling, planning, managing and effective use of one's study time. (Behaviour Regulation)

29. I perform poorly on exams because of poor time planning.

33.I often record how much time I spend for studying.

36.I usually get time to review all lessons before final exam.

37.I often set specific time to study and carries through with it.

38.I make sure that I keep up my learning with class teacher's lectures every week.

40.I often procrastinates/put off studying.

43.I set aside more time to learn difficult lesson.

3. Determining self-report inventory as a format for measurement

Investigator adopted the protocol of self-report inventory because designing, administration, scoring and interpretation will be relatively easy. Here students have to provide information about their own memories and interpretation of their own actions related to learning process which typically researcher cannot observe. Students have to respond using 5-point scale anchored by Never, Seldom, Sometimes, Often, Always. It can be administered in group or for a single student. For intervention purposes drawing the profile will be more useful.

Self -regulated learning is defined as an aptitude (as a relatively enduring attribute of a person that predicts future behaviour) because items are constructed as generalised actions across situations rather than as a specific learning event (not like, e.g.: asking students to speak out aloud, the thought related to their learning

processes while they actually perform a task) and items are framed as descriptive statements (e.g., I teach lessons to my friends). When measured as an aptitude self-regulated learning strategy used can vary based on time of measurement, so it would be preferable to administer the instrument three to one month before an upcoming Examination.

4. Have initial item pool reviewed by experts and Pilot testing

Before writing items discussions on concept of self - regulated learning was done with experts in the field of psychology. The main concern was about whether items can be developed as indicating general learning or should it be focusing only on learning a specific subject. It was decided that items can be developed generally but a space would be provided so that if responded feel he/she want to specify each subject differently they can mark it differently. After writing items, initial item pools were reviewed with experts, on how relevant each item is to what it intends to measure and to include any phenomenon that investigator failed to include. The experts were selected based on expertise in any field such as; expertise in the field of learning and teaching, experience in construction and standardization of a psychological tool, their contact with high school students of Kerala, knowledge on the concept of self-regulated learning, also knowledge on sentence construction. Experts were contacted by person and a discussion about the topic was made especially on their role as an expert. Each expert was given a draft copy of inventory. Each items were placed under respective dimension and sub dimensions. A write up was also given, explaining the concept of self-regulated learning and briefing each dimension separately. The expert had to do a mock filling of inventory

also for cross checking for content validity, whether students could comprehend questions, whether the response category was appropriate, was there any ambiguity, complex statements, double barrelled statements, if items assess same strategies in question. While they administered the items to themselves, self-reflective thoughts were written down. The ambiguous items were identified and rewritten based on expert's insightful comments. Items clarity and conciseness were checked and problematic wordings were corrected. Finally, a good set of item pool with appropriate wording, vocabulary, and sentence structure were obtained for pilot testing. A pilot testing was done for 50 students and found that separate column for specific subject is unnecessary and created ambiguity. So, initial draft was prepared without space for specific subjects. Draft was prepared in English - Initial draft with 68 items is appended as appendix D.

5. Item analysis

Valid items suited for measuring the variable were determined through different statistical procedure.

Sample. Sample consists of 400 high school students from Kerala board English Medium Schools. Sample includes both male and female with varying socio-demographic characteristics. In order to concentrate on adequacy of items and to eliminate subject variance, about 400 samples administered the initial draft of the inventory. Selection of few samples was risk as pattern of covariance among items may not be stable. Potentially good item may be excluded because their correlations with other items were attenuated purely by chance. Small sample may not represent population for which the scale was intended. So, it was decided to collect 400

samples. Based on general rule of thumb 1:5 (Tinsely, 1987), the sample size has to be 340, but a little more data was collected, thus rounded up as 400.

Administration. Different schools were approached and permission was obtained from head masters**.** After explaining the importance of the study, inventory was administered to students in group. Purpose of the test was discussed in brief, and then instructions were given clearly. They were asked to write the Socio-demographic details first, then they could mark their response in respective space provided. All doubts and query were taken into consideration. Sample who didn't finish the test or skipped any items were removed.

Method of scoring. For every item, items are scored 0, 1, 2, 3, and 4 respectively for responses never, seldom, sometimes, often, always. Negative items are reverse scored. Total score for each dimension was obtained by adding scores of respective items. Maximum total score would be 272. For ease of scoring stencils were also developed.

6. Item selection

Individual performance of each item was evaluated, so that appropriate items can be identified. At first responses of each student were entered into an excel sheet for each and every item. Total scores were calculated, then, total score of 400 samples were arranged in ascending order. 27 % of low scorers and 27 % of high scorers were selected as low and high group respectively. 108 students ended up as low scorers and another 108 students were ended up as high scorers. Then, Items were eliminated based on following criteria.

Mean. It was assumed that for each positive item low scorers mean would be less than high scorers mean. For 3 items, Item number 11, 12 and 41, low scorers got higher mean than high scorers. Details of mean scores are given in Table 3.

Item discrimination. For finding out if an item could discriminate between a low scorer and a high scorer, independent sample 't' test was administered. The 't' value obtained for each item is provided in the Table 3. Assumption of homogeneity of variance was tested using Leven's test of equality of variance. Output was given by SPSS V.20 statistics when independent 't' test is run. If the significance value is greater than 0.05, group variance is treated as equal. All most all items have significance value greater than 0.05. So 't' value for equal variance assumed was taken into consideration. The 't value' greater than 2.58 indicate a good discriminating power (as proposed by Edwards, 1957) and such items were selected. Thus, based on above result, items with *t* values less than 2.58 were rejected. Rejected item numbers are 23, 25, 44, 29.

Corrected item total correlation. Corrected item-total correlation (Point Biserial Correlation) was also calculated for 400 sample. The best criteria for including an item in the test is that it should have a corrected item total correlation of 0.25 or above. Based on above criteria, items 45, 47, 49, 53 were rejected (Devellis, 1991).

Cronbach's Alpha if Item Deleted. Cronbach's alpha if item deleted was also calculated for 400 sample and it was found that item 40, if deleted would actually increase the reliability of the test (Devellis, 1991).

Table 3

Mean, SD and t Value, Corrected Item Total Correlation of Items in the Self-Regulated Learning Strategy.

Item No	Low score group		High score group		t value n=108	Corrected item total correlation
	Mean	SD	Mean	SD		
Item 1	2.49	0.859	3.35	0.753	7.834	0.464
Item 2	2.46	1.097	3.63	0.635	9.562	0.529
Item 3	1.96	1.399	2.96	1.304	6.945	0.413
Item 4	1.67	1.200	2.53	1.036	5.645	0.380
Item 5	2.58	1.305	3.78	0.674	8.450	0.512
Item 6	3.09	1.264	3.92	0.435	6.404	0.348
Item 7	2.16	1.254	2.16	0.789	8.377	0.467
Item 8	1.29	1.347	2.44	1.648	5.606	0.341
Item 9	2.53	1.370	3.72	0.544	8.419	0.539
Item 10	2.40	1.168	3.35	1.088	6.211	0.424
Item 11*	0.81	1.153	0.64	1.404	1.006	-0.77
Item 12*	1.33	1.553	0.78	1.443	2.724	-0.228
Item 13	2.38	1.331	3.47	0.742	7.453	0.498
Item 14	2.17	1.140	3.52	0.662	10.657	0.571
Item 15	2.81	1.201	3.84	0.583	8.002	0.442
Item 16	2.87	1.169	3.87	0.412	8.385	0.494
Item 17	3.12	1.065	3.90	0.472	6.936	0.430
Item 18	1.53	1.53	2.94	2.94	8.020	0.492
Item 19	1.85	1.345	3.32	0.905	9.436	0.583
Item 20	1.76	1.303	3.05	1.054	7.981	0.496
Item 21	1.82	1.167	3.44	0.715	12.307	0.667
Item 22	2.46	1.203	3.57	0.686	8.337	0.509

Item No	Low score group		High score group		t value n=108	Corrected item total correlation
	Mean	SD	Mean	SD		
Item 23*	1.79	1.290	2.18	1.497	2.045	0.129
Item 24	2.28	1.229	3.54	0.880	8.657	0.566
Item 25*	1.58	1.291	2.02	1.332	2.438	0.104
Item 26	2.64	1.293	3.48	0.912	5.534	0.403
Item 27	2.18	1.252	3.49	0.815	9.149	0.550
Item 28	2.09	1.107	3.56	0.631	11.931	0.628
Item 29*	1.60	1.282	1.93	1.412	1.766	0.062
Item 30	2.96	1.296	3.51	0.962	3.517	0.255
Item 31	2.57	1.652	3.58	1.128	5.148	0.279
Item 32	2.60	1.240	3.59	0.918	6.799	0.386
Item 33	1.81	1.409	3.06	1.267	6.807	0.414
Item 34	1.81	1.123	3.06	1.015	9.917	0.581
Item 35	2.16	1.209	3.37	1.047	7.884	0.481
Item 36	2.29	1.200	3.38	0.782	7.927	0.475
Item 37	1.186	1.86	3.33	3.33	9.216	0.590
Item 38	1.30	1.087	2.90	.808	12.287	0.631
Item 39	1.55	1.226	2.97	.990	9.404	0.584
Item 40*	1.66	1.276	2.16	1.467	2.672	0.160
Item 41*	2.19	1.377	1.16	1.161	5.982	-0.435
Item 42	1.28	1.191	2.82	1.175	9.608	0.553
Item 43	1.74	1.233	3.30	0.878	10.678	0.622
Item 44*	1.89	1.263	2.00	1.421	.607	0.027
Item 45 *	1.64	1.357	2.21	1.441	3.015	0.178
Item 46	2.91	1.124	3.73	.705	6.456	0.434
Item 47*	2.62	1.302	3.20	1.302	3.292	0.202
Item 48	2.08	1.361	3.42	1.060	8.031	0.520

Item No	Low score group		High score group		t value n=108	Corrected item total correlation
	Mean	SD	Mean	SD		
Item 49 *	1.35	1.342	1.96	1.503	3.152	0.212
Item 50	1.73	1.287	3.11	1.008	8.031	0.538
Item 51	2.32	1.214	3.71	.530	3.152	0.580
Item 52	1.77	1.364	2.81	1.276	8.772	0.373
Item 53*	2.69	1.336	3.23	1.157	10.896	0.194
Item 54	1.41	1.168	2.65	1.138	5.820	0.486
Item 55	1.31	1.31	3.01	3.01	11.290	0.640
Item 56*	1.86	1.249	3.40	.820	10.692	0.650
Item 57	2.11	1.256	3.53	.779	9.964	0.611
Item 58	2.06	1.310	3.24	.965	7.568	0.488
Item 59	1.77	1.309	2.82	1.040	6.568	0.411
Item 60	1.90	1.127	3.04	1.076	7.247	0.492
Item 61	2.15	1.214	3.20	.904	7.247	0.473
Item 62	2.08	1.347	2.93	1.108	5.019	0.319
Item 63	1.56	1.396	2.59	1.192	5.818	0.376
Item 64	2.01	1.279	3.49	.791	10.238	0.638
Item 65	2.18	1.206	3.53	.791	9.741	0.564
Item 66	2.25	1.340	3.44	.715	8.171	0.531
Item 67	2.79	1.297	3.72	.708	6.575	0.415
Item 68	2.03	1.186	3.55	.617	9.716	0.594

*Note: * Items which are rejected based on different criterion.*

Thus, a total of 12 items were marked for deletion. The item numbers are **11, 12, 23, 25, 29, 40, 41, 44, 45, 47, 49 and 53**, resulting in acceptance of 56 items.

Factor Analysis

Factor analysis is a statistical technique widely used in psychology to simplify a complex set of data and describe variability among observed variables, thus reducing large number of observed variables into fewer unobserved variables. It can be exploratory or confirmatory. The goal of latent variable measurement models (i.e., factor analysis) is to establish the number and nature of factors that account for the variation and covariation among a set of indicators. In exploratory factor analysis maximum common variance from all variables are extracted and put into a common score. “Traditionally it is used to explore the possible underlying structure of a set of observed variables without imposing a pre conceived structure on the outcome (Child 1990). Confirmatory factor analysis (CFA) is a statistical technique used to verify the factor structure of a set of observed variables. CFA allows the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists. The researcher uses knowledge of the theory, empirical research, or both, postulates the relationship pattern a priori and then tests the hypothesis statistically” (Suhr, 2006).

One of the common agreements in the rules of scale development (especially in earlier stages of tool construction) is that Confirmatory factor analysis is employed on a different set of data, to confirm the factor structure obtained through Exploratory factor analysis. As EFA allow for cross loadings, the researcher often get confused whether to follow a factor structure suggested through EFA that is not confirming to well defined hypothesised theory. If theoretically the concept is well defined, and EFA suggest a different factor structure, in such case there is no

specific rule to be applied. The most prominent method is to rewrite items and collect a new data set and do validation. But there are some scholars who argue that validation of scale through CFA is enough if the hypothesised theory is well defined.

The observations about continuing debate on EFA v/s CFA is addressed along with Exploratory factor structure of present test in the general observation section observation section (pg.158). For this particular study, factor structure obtained through EFA is not followed as it doesn't any way represent the theoretical model the researcher is interested in. Factors emerged from EFA had different sets of items as opposed to actual conceptual theory which lead to chaos in terms of jumbled factors. EFA is useful when the researcher doesn't know how many factors there are or when it is uncertain when what indicators load on what factor. DeVellis (2016) suggest that "same analysis can be used on the same data set either to determine what their underlying structure is or to confirm a particular pattern of relationship predicted on the basis of theory or previous analytical results". Hurley (1997) suggest reasons proposed by Nunnally and Berstein (1994) to avoid using EFA in scale development when poor item distribution and difficult factor structure occur. Teng and Zang (2016) in an attempt to validate newly developed "The Writing Strategies for Self-Regulated Learning (SRL) Questionnaire" with respect to proposed multifaceted structure of SRL strategies framed within the SRL theory, subjected the instrument directly to a series of CFA rather than going for exploration through an EFA, in order to examine its factorial structure.

So, it was decided that Confirmatory factory analysis can be tried out for validation.

Confirmatory Factor analysis is part of structural equation modelling and represent measurement model. It signifies the relationship between measures or indicators and latent variables or factors. Main feature of CFA is that it is hypothesis driven nature. CFA requires the researcher to prespecify all aspect of the model. Thus, researcher must have a firm priori sense, based on past theory, about the number of factors that exist in the data, indicators are related to which factors and so forth. CFA is used during the processes of scale development to examine the latent structure of test. In this context CFA is used to verify the number of underlying dimensions of the instrument (factors) and the pattern of item factor relationship (factor loading). (Brown,2015)

Here, CFA is utilised in the sense to confirm the hypothetical factor structure of Self-regulated learning strategy derived from theoretical models, mainly from Zimmerman interview protocol (Zimmerman, & Martinez-Pons, 1986) and Pintrich et al., (1991) theoretical framework on general view on motivation and learning strategies

Confirmatory Factor Analysis of Self-regulated learning strategy

CFA is used to assess the overall measurement of Self-regulated learning strategy as there are multiple items to measure it. The strength of CFA is that it models and accounts for measurement errors in indicators, leaving the latent variable, representing the concept, free of measurement error. CFA is used to specify and test a measurement model for self-regulated learning strategy with five dimensions. Here, item values are assumed to be caused by two sources: the latent variable and measurement error.

Input model with prespecified indicators for each dimension was first entered to AMOS V 22 and parameters were estimated. Mis specification in the data is dealed. Item with significant factor loading with factor score value more than 0.30 was retained, items with high standard residual variance was deleted, modifications was done also based on model fit indices. Final models are presented here with adequate model fit.

Model fit were assessed at three levels ("Learn to perform", 2019):

I. **Overall model level**.

Many fit indices for overall model can be seen in literature. Each one indicates if the specified or hypothesised relationship between latent variables and indicators is similar to relationship between observed variables in the data. i.e. it represents discrepancies between observed and model-implied data. Holmes-Smith et al., (2006) recommend at least one fitness Index from each category of model fit. Present research followed criteria suggested by Kline (2005).

1. Absolute fit indices

"Absolute fit indices determine how well a priori model fits the sample data" (Hooper et al.,2008).

a) "Model Chi-square: A hypothesis test statistic for the null hypothesis that the model fits perfectly. It assesses the discrepancy between the sample and fitted covariances. However, it is sensitive to sample size, such that in large samples, it can be high even if the model is a good

one. Cut-off: A good model is one with a p-value greater than .05, indicating that the null hypothesis should not be rejected" ("Learn to perform", 2019) ."It is very common for chi square statistic test to be significant, which indicates that the model from the researcher's data does not fit the hypothesised model. There are two common reasons for this problem. (a) The researcher may have mis specified the model or (b) the large sample size is contributing to a stronger likelihood of statistical significance, despite minor deviations from the hypothesised model. There is no one to ascertain when (a) or (b) occur. In such cases researcher provide evidence of other model fit." (Balikin & Kleist, 2017)

As in present CFA model's chi square value was significant, chi-square value by degrees of freedom (χ^2/df) was looked upon as evidence for model fit with values of 5 or less (Hu et al., 1999).

b) "RMSEA: The root mean square error of approximation is a parsimony adjusted fit index, meaning that it favours simplicity in models" ("Learn to perform", 2019). It provides discrepancy value between hypothesised model and estimated population model based on sample data. The closer the value is to 0, the better the model and cut off between 0.08 to 0.10 provides a mediocre fit and below 0.08 shows a good fit (MacCallum et al, 1996).

c) "SRMR: The standardized root mean square residual is the square root of the standardized difference between the sample covariances

and the covariances predicted by the model (“Learn to perform”, 2019).“The range of the RMR is calculated based upon the scales of each indicator, therefore, if a questionnaire contains items with varying levels (some items may range from 1 – 5 while others range from 1 – 7) the RMR becomes difficult to interpret standardised RMR (SRMR) resolves this problem and is therefore much more meaningful to interpret. Values for the SRMR range from zero to 1.0 with well-fitting models obtaining values less than 0.05”. (Hooper et al.,2008).

2. Incremental fit indices

“Indices that do not use the chi-square in its raw form but compare the chi-square value to a baseline model. For these models the null hypothesis is that all variables are uncorrelated” (Hooper et al.,2008).

d) “CFI: The comparative fit index reflects the correlations among observed variables in the model. Higher correlations among the variables produce higher CFI values” (“Learn to perform”, 2019). “CFI statistic range between 0.0 and 1.0 with values closer to 1.0 indicating good fit. A cut-off criterion of CFI $\geq$ 0.90 was initially advanced however, recent studies have shown that a value greater than 0.90 is needed in order to ensure that mis specified models are not accepted.” (Hooper et al.,2008).

3. Parsimony fit indices

“Having a nearly saturated, complex model means that the estimation process is dependent on the sample data. This results in a less rigorous

theoretical model that paradoxically produces better fit indices. Parsimony fit indices overcome this problem" (Hooper et al.,2008).

e) "Parsimonious Normed Fit Index (PNFI): The PNFI adjusts for degrees of freedom based on the NFI. It seriously penalises for model complexity which results in parsimony fit index values that are considerably lower than other goodness of fit indices. While no threshold levels have been recommended for these indices, it is possible to obtain parsimony fit indices within the 0.50 region while other goodness of fit indices achieve values over 0.90" (Hooper et al.,2008).

II. Equation Level Fit.

"The most frequently used equation level fit measures are R2 values. There is an equation for every observed variable or item in a CFA model; therefore, an R 2 value is reported for each item. R 2 values range from 0 to 1. Higher values indicate better equation level fit" ("Learn to perform", 2019).

III. Parameter Level Fit

"Factor loadings or the coefficients linking the latent variables and the items are the parameters most often assessed. Because they are fundamentally simple regression coefficients in CFA, the same hypothesis tests apply to factor loadings as to regression coefficients. The null hypothesis is that the factor loading is equal to 0, the alternative is usually that the factor loading is not equal to 0, but one-sided alternative hypothesis

tests can be performed as well. Factor loadings estimated with Maximum Likelyhood generally use z-tests. The choice of level of significance for the test is made by the researcher because the actual p-value is reported. The assessment of the statistical significance of each factor loading with these tests lets the researcher know if the latent variable is related to a particular observed variable or item. Non-significant items can be trimmed from CFA models and they can be re-estimated. Such model fitting is typical for CFA, as for all SEM models." ("Learn to perform", 2019)

First order confirmatory factor analysis

As the model had large number of indicators for each factor, CFA for each dimension was performed separately. In the initial measurement model had five dimensions with Motivation dimensions having 15 items, metacognitive dimensions having 11 items, cognitive dimensions having 15 items, behaviour regulation having 9 items and emotion regulation having 6 items. Initial models specified had poorly fitting. So, the researcher decided for prespecifying and estimating the model. After model re-specification, the accepted models are depicted in Figures 6 to 10. Each CFA was found to have an excellent fit on various fit indices. Table 4 provides information regarding model fit indices of each dimension of Self-regulated learning separately.

As maximum likelihood method was employed for extraction, it was confirmed that data was normally distributed. Mean, median, mode of each item was approximately equal. The value of Skewness and Excess Kurtosis was within -1 to +1.

Motivation Regulation

In the input model, initially items 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, and 17 were included as indicators for unobserved motivation regulation factor, and the model was not fit. So, modal re-specifications were carried out. Final model is represented in Figure 6 and model indices are given in table 4.

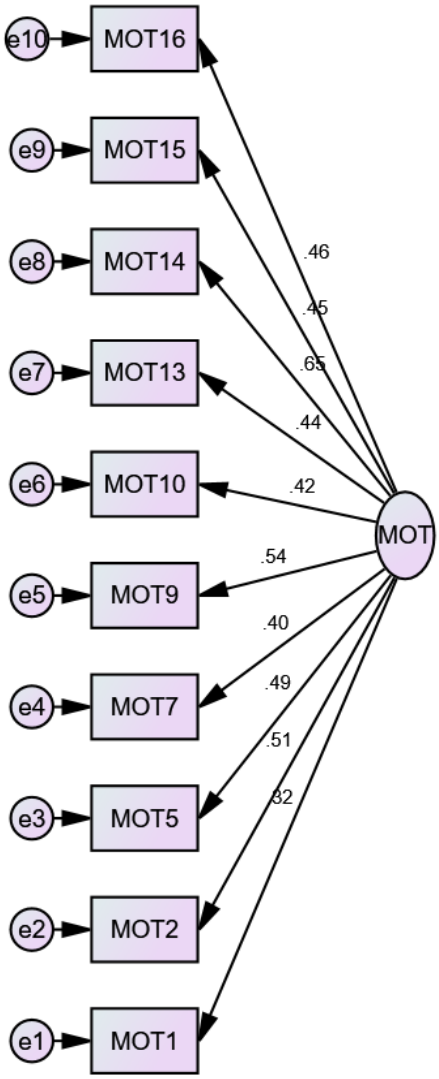

Figure 6: Confirmatory Model of Motivation Regulation

Metacognitive Regulation

In the input model, initially items 18, 19, 20, 21, 22, 24, 26, 27, 28, 30, and 57 were included as indicators for unobserved metacognitive regulation factor, and the model was not fit. So, modal re-specifications were carried out. Final model is represented in Figure 7 and model indices are given in table 4.

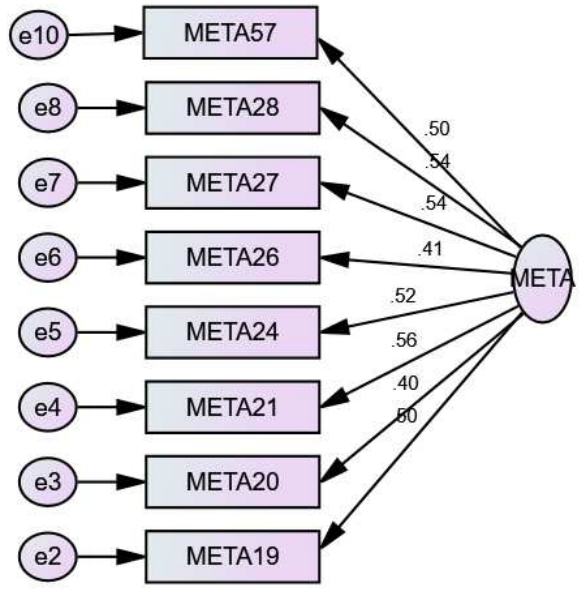

Figure 7: Confirmatory Model of Metacognitve Regulation

Cognitive Regulation

In the input model, initially items 42, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, and 68 were included as indicators for unobserved cognitive regulation

factor, and the model was not fit. So, modal re-specifications were carried out. Final model is represented in Figure 8 and model indices are given in table 4.

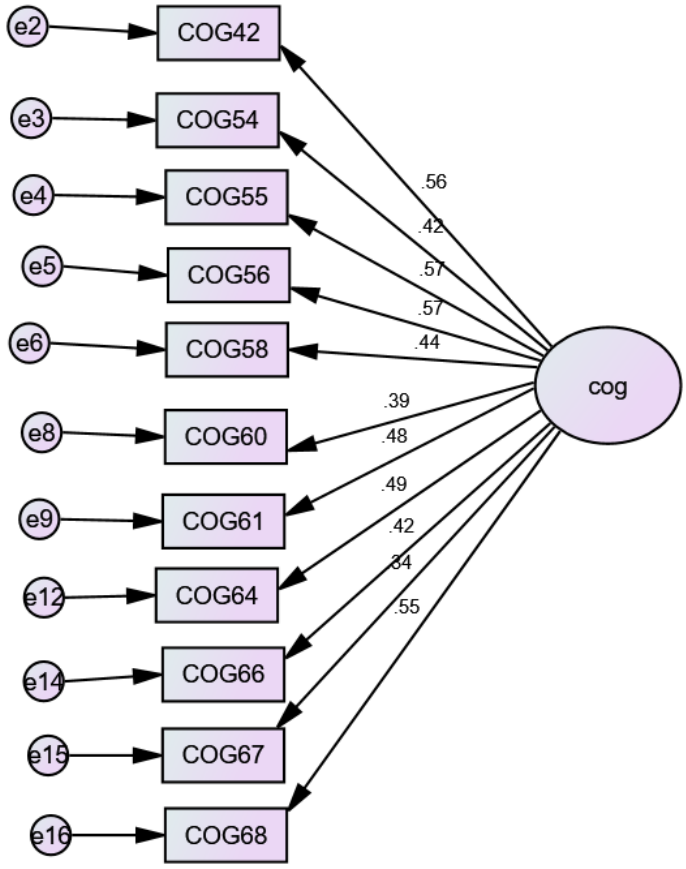

Figure 8. Confirmatory Model for Cognitive Regulation

Emotion Regulation

In the input model, initially item 50,51,52,39,46,48 were included as indicators for unobserved emotion regulation factor, and the model was fit. So, initial modal was accepted. Final model is represented in Figure 9 and model indices are given in table 4.

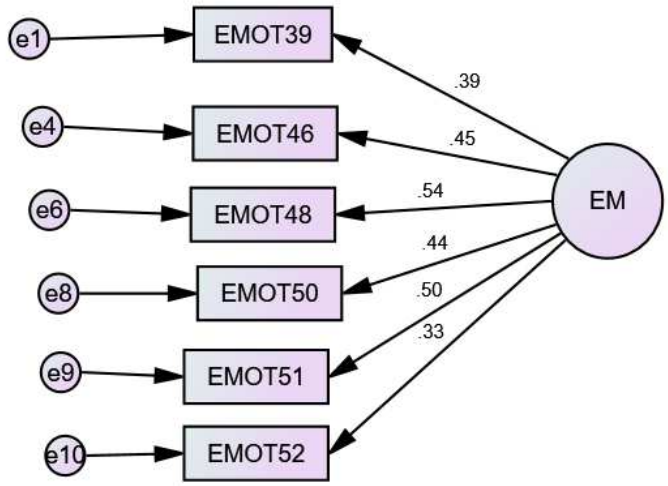

Figure 9. Confirmatory Model of Emotion Regulation

Behaviour Regulation

In the input model, initially item 31, 32, 33, 36, 37, 38, 43,35,34,32, were included as indicators for unobserved behaviour regulation factor, and the model was not fit. So, modal re-specifications were carried out. Final model is represented in Figure 10 and model indices are given in table 4.

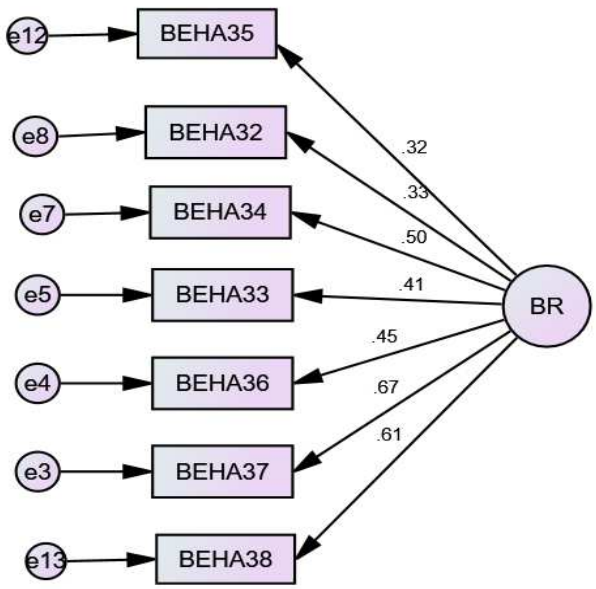

Figure 10. Confirmatory Model of Behaviour Regulation

Table 4

Model fit summary and Cronbach alpha for each dimension of SRLS

Indices	Motivation Regulation	Meta-cognitive Regulation	Cognitive Regulation	Emotion Regulation	Behaviour Regulation
Number items (initial model)	15	11	15	6	9
Number of items final model)	10	8	11	6	7
Chi-square/Df	2.05	2.32	2.31	1.19	1.59
PNFI	0.677	0.640	0.681	0.564	0.621
CFI	0.928	0.937	0.908	0.989	0.973
RMSEA	0.05	0.05	0.57	0.02	0.39
SRMR	0.04	0.042	0.047	0.028	0.034
Cronbach's Alpha	0.736	0.721	0.763	0.581	0.657

From the Table 4, it was observed that all models of all dimensions have Chi-square value/DF less than 5.00 which indicate perfectly fit. RMSEA value was 0.5 or below and shows reasonable fit. Comparative Fit Index (CFI) was > 0.90 with all SRMR value below 0.05. These values indicated perfect fit. Cronbach's Alpha was found to be above 0.7 for all dimensions except for emotion regulation dimension which was just adequate (0.58). Reliability indicates internal consistency of the items within each dimension.

Second order confirmatory factor analysis for SRLS

The literature review and theoretical model suggest a strong hypothesis for a construct self-regulated learning strategy as a second order factor. Table 5 shows significant correlation between the dimensions. So, it was hypothesised that items on Self-regulated learning strategy are better represented by a second order structure such that (overall) self-regulated learning causes the lower order factors of motivation regulation, metacognitive regulation, cognitive regulation, behaviour regulation, emotion regulation, which in turn cause the observed behaviour tapped by items.

Teng and Zang (2016) "has reported the validation of a self-report questionnaire, the WSSRLQ, to evaluate the perceived use of writing strategies for SRL in EFL learning environments. The CFA results confirmed that the nine EFL writing strategies for SRL represented reliably distinguishable but correlated aspects under an overarching construct of self-regulation". Mousoulides and Philippou (2005), in a SEM based study found that 26 indicators represented one high order, one second order and nine first-order factors with good model fit. Khampirat (2011)

report “the quality of the model-data fit confirms the construct validity of MSLQ; the first- and second-order factor loadings are significant at $p < .05$, with standardized first-order factor loadings of 0.929 for motivation factor and 0.556 for learning strategies”.

Table 5

Correlation between Five Dimensions of SRLS-Inventory

Dimensions	Motivation regulation	Meta-cognitive regulation	Cognitive regulation	Behaviour regulation	Emotion regulation
Motivation regulation	1	0.620**	0. 529**	0. .473 **	0. .521 **
Meta-Cognitive regulation		1	0. 663 **	0. 614**	0. 570**
Cognitive regulation			1	0. 631**	0. 593 **
Behaviour regulation				1	0.533**
Emotion regulation					1

** Significant at 0.01 level

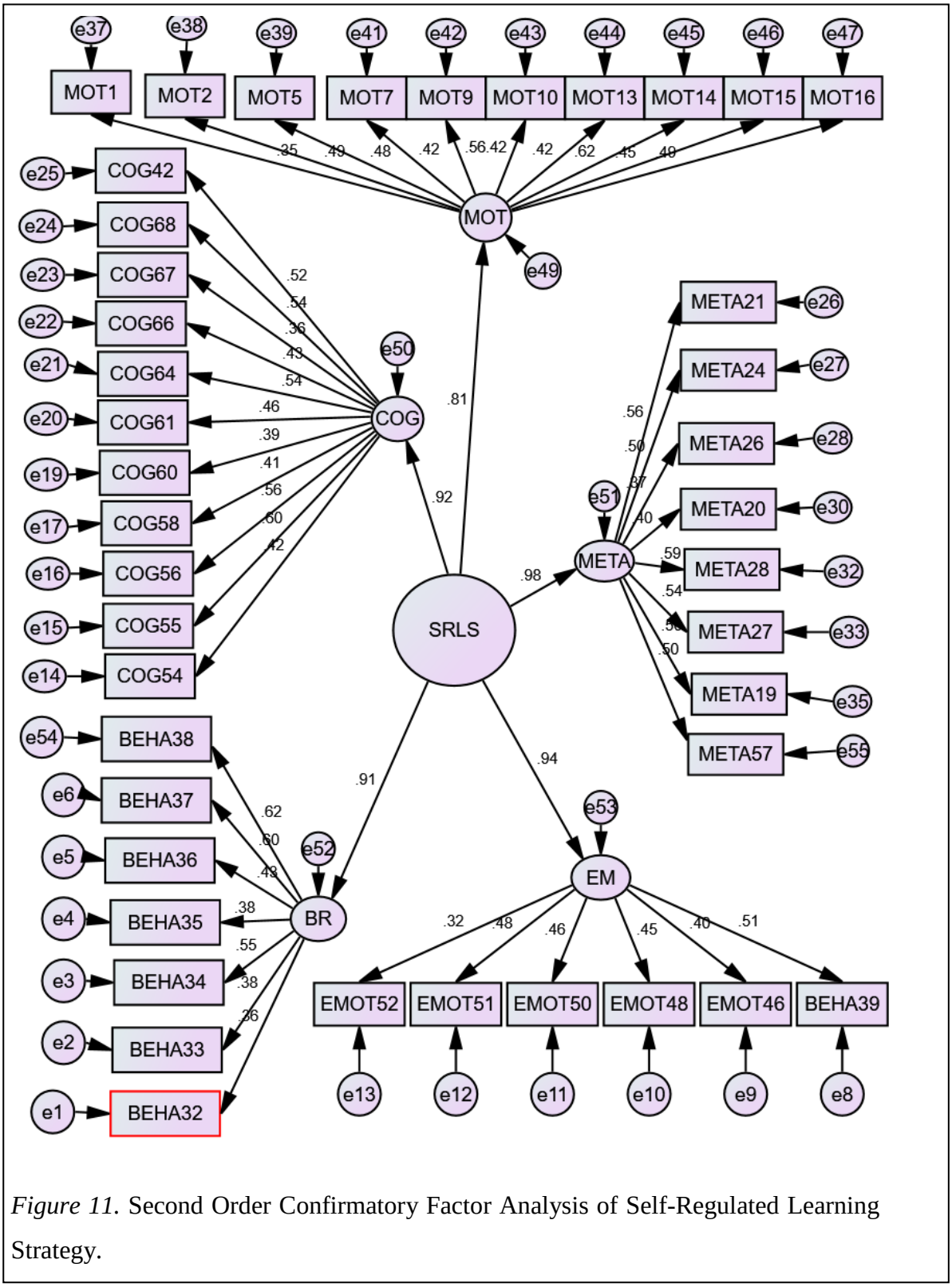

Figure 11. Second Order Confirmatory Factor Analysis of Self-Regulated Learning Strategy.

Note: SRLS- self regulated learning strategy, MOT- motivation regulation, COG- cognitive regulation, EMOT- emotional regulation, BEH -behaviour regulation, META- metacognitive regulation

Table 6

Unstandardized Loadings (Standard Errors) and Standardized Loadings for Second Order- Confirmatory Factory Analysis Model of Self-regulated Learning Strategy

Variables			Unstandardised Coefficient (B)	S.E.	Standardised Coefficient (Beta)	P Value
MOT	<---	SRLS	.265	.042	.809	<0.001**
COG	<---	SRLS	.488	.061	.918	<0.001**
BEH	<---	SRLS	.363	.055	.912	<0.001**
META	<---	SRLS	.646	.057	.983	<0.001**
EM	<---	SRLS	.595	.061	.940	<0.001**
BEH32	<---	BR	1.000		.358	
BEH33	<---	BR	1.360	.268	.380	<0.001**
BEH34	<---	BR	1.628	.272	.553	<0.001**
BEH35	<---	BR	1.153	.228	.377	<0.001**
BEH36	<---	BR	1.170	.217	.430	<0.001**
BEH37	<---	BR	1.880	.305	.604	<0.001**
EM39	<---	EM	1.000		.510	
EM46	<---	EM	.595	.094	.401	<0.001**
EM48	<---	EM	.900	.130	.451	<0.001**
EM50	<---	EM	.913	.130	.460	<0.001**
EM51	<---	EM	.841	.116	.485	<0.001**
EM52	<---	EM	.695	.132	.317	<0.001**
COG54	<---	COG	1.000		.422	
COG55	<---	COG	1.445	.199	.597	<0.001**
COG56	<---	COG	1.269	.181	.557	<0.001**
COG58	<---	COG	.963	.161	.415	<0.001**
COG60	<---	COG	.839	.146	.386	<0.001**
COG61	<---	COG	.988	.154	.463	<0.001**

Variables			Unstandardised Coefficient (B)	S.E.	Standardised Coefficient (Beta)	P Value
COG64	<---	COG	1.187	.172	.539	<0.001**
COG66	<---	COG	.921	.151	.428	<0.001**
COG67	<---	COG	.711	.129	.365	<0.001**
COG68	<---	COG	1.052	.153	.537	<0.001**
COG42	<---	COG	1.291	.191	.516	<0.001**
META21	<---	META	1.000		.562	
META24	<---	META	.868	.106	.498	<0.001**
META26	<---	META	.623	.097	.370	<0.001**
META20	<---	META	.790	.115	.402	<0.001**
META28	<---	META	.929	.101	.586	<0.001**
META27	<---	META	.906	.105	.535	<0.001**
META19	<---	META	.933	.115	.495	<0.001**
MOT1	<---	MOT	1.000		.354	
MOT2	<---	MOT	1.491	.266	.493	<0.001**
MOT5	<---	MOT	1.655	.299	.476	<0.001**
MOT7	<---	MOT	1.414	.270	.422	<0.001**
MOT9	<---	MOT	1.847	.315	.555	<0.001**
MOT10	<---	MOT	1.452	.277	.422	<0.001**
MOT13	<---	MOT	1.463	.278	.425	<0.001**
MOT14	<---	MOT	1.942	.320	.619	<0.001**
MOT15	<---	MOT	1.295	.241	.447	<0.001**
MOT16	<---	MOT	1.405	.252	.486	<0.001**
BEH38	<---	BR	1.801	.290	.615	<0.001**
META57	<---	META	.873	.107	.499	<0.001**

Model Fit Indices: $\chi 2 = 1351.248$ $p = .000$; CMIN/DF = 1.660; RMSEA = 0.04; CFI = 0.841; PNFI = 0.643; SRMR = 0.05.

A second order factor analysis was conducted to examine multidimensionality of theoretical concept of SRLS and for confirming hypothesised second order higher order factor structure of Self-regulated learning strategy. The results of validating measurement model include the parameter estimation as well as fit of the model as whole. The value of factor loading of each indicator to respective dimension varied from (0.595 -1.9). The value of standardised estimate varied from (0.31-0.619). Factor loadings were significant for all estimate. Each of the first order factors loaded strongly onto the second order self-regulated learning strategy factor (range of loading=0.809-0.983). In addition, the higher order SRLS factor was found to explain 65% – 96 percent of variance in the five lower order factors.

The chi square value of the model is 1351.248 with degrees of freedom equal to 814. The value of CMIN/DF is 1.660 which is less than 5 and thus the initial hypothesised model was acceptable. The value of RMSEA and SRMR is below 0.5 with PNFI value of 0.643. All these indices support the model has good fit. The CFI value indicate model is just reasonable in that respect. But overall model validates the self-regulated learning strategy – SRLS is a second order construct with five dimensions – Motivation regulation, Meta cognitive regulation, Cognitive regulation, Behaviour regulation and Emotion regulation.

7. Reliability and Validity

Validity. The inventory has face validity. Convergent validity of this test with Academic motivation scale (AMS) (Vallerand et al., 1992) was also found. The bivariate correlation indicated that self-regulated learning strategies were significantly positively correlated with academic motivation. But strength of this

relation was weak. Correlation coefficient obtained was 0.202, significant at 0.05 level.

Multicollinearity. It was also confirmed that multi-collinearity was within acceptable range (below 0.8) by investigating the correlations. See Table 5.

Reliability. To check the internal consistency of the scale, Cronbach's Alpha was found out. The test has coefficient of alpha of 0.906 for 42 items.

The final version of self-regulated learning strategies inventory is appended at appendix E.

Chapter 4

Result and Discussion

- **Preliminary analysis.**
- **Relationship between Variables of present research**
- **Mediator analysis**
- **Path analysis**

In this chapter the results obtained from analysis of the data is presented and discussed. Data analysis techniques such as correlation analysis, regression analysis, and analysis of variance are carried out using SPSS V20 – Statistical Package for Social Science Researchers – and path analysis using AMOS V22 to test the formulated hypothesis. Results are presented as sections based on the order of hypothesis formulated. During data analysis some inconsistencies were seen in result obtained, so they are discussed from a critical analysis perspective in general observation section.

In section 1, preliminary analysis is carried out to obtain descriptive statistics of central tendency, dispersion and shape of distribution of the data set. In section 2, correlation analysis is carried out in order to find inter relationship between variables - 'Intelligence, self-regulated learning strategies, Academic achievement. In section 3, Analysis of variance (ANOVA) is carried out to assess the role of some socio-demographic variables. In section 4, mediation analysis is carried out using Bootstrap method. In section 5, different models of Self-regulated learning are tested using AMOS V22 – Analysis of a moment structures in order to find the best fit model**.** In section 6, a brief discussion on standardisation issues of tests used in present research **is** written.

Section 1: Preliminary analysis

Fundamental descriptive statistics like central tendency (mean, median, mode), measures of dispersion like standard deviation and Skewness and Kurtosis of variables are presented. Thus, a large volume of data is summarised in order to get an understanding of important aspect of data set.

Arithmetic average of data set called arithmetic mean is calculated as it is the commonly used and useful descriptive value of any distribution. Standard deviation of the data set gives an idea of how much the values in data set differ from the mean value for the whole data set. A low standard deviation indicates values in data are close to the mean and high standard deviation indicates values are spread out. Some of the features of normal distribution are symmetric bell-shaped curve, mean = mode= median with Skewness (shape of curve i.e. lack of symmetry) of zero. Negatively skewed distribution has a long tail towards the left and indicate mean and median less than mode. Positively skewed distributions have a tail of curve extended to the right and indicate that mode is less than median. Kurtosis measures outliers of the distribution. Positive kurtosis values indicate more outliers than normal distribution and a thick tail. Negative Kurtosis indicate distribution is prone to less outlier than normal distribution and a thin tail. In reality a distribution doesn't exactly follow all assumptions for normality, so, certain rule of thumbs have been proposed, a) If Skewness value does not lie between +2 to -2, then distribution is markedly different from normal distribution in symmetry; b) If kurtosis value is >3 ,then the distribution is markedly different from normal distribution in its tendency to create outliers (Bachman , 2004; Westfall & Henning, 2013). As this is a less reliable method for sample size less than 300, z- test is applied for descriptive statistics of present sample. For obtaining z values skew values or excesses kurtosis are divided by their respective standard errors. "For medium sized samples $50<n<300$ reject null hypothesis at absolute z value over 3.29, and conclude distribution of sample is non- normal" (Kim, 2013).

Hypothesis (1): The sample data are not significantly different than a normal population.

Mean, median, mode, standard deviation, skewness and kurtosis, z value of the sample for variables intelligence, academic achievement, self-regulated learning strategies and its dimensions are presented in the table no 7. For testing normality skewness value or excess kurtosis value is divided by respective standard error and obtained test statistic measures how many standard errors separate the sample.

Table 7

Basic Descriptive Statistics of Variables

Variables	Mean	Mode	Median	S. D	Skewness	Kurtosis	z_1	z_2
Academic Achievement	398.60	388	375	84.36	0.32	-0.45	1.52	1.07
IQ	102.97	103	100	8.38	0.30	1.22	1.46	2.92
VIQ	106.70	106.80	100	10.72	0.14	-0.46	0.69	1.10
PIQ	99.26	100	95	9.84	0.28	3.47	1.32	7.94
SRLS	160.95	165	153	25.56	-0.42	-0.33	2.01	0.79
Motivation Regulation	46.65	48	48	7.05	-0.83	0.35	3.98	0.84
Meta Cognitive Regulation	29.24	30	31	6.22	-0.49	-0.08	2.38	0.20
Cognitive Regulation	43.35	44	46	8.77	-0.42	-0.19	2.01	0.46
Emotion Regulation	14.30	15	18	3.59	-0.37	-0.58	1.76	1.34
Behaviour Regulation	27.41	28	30	6.37	-0.42	-0.29	1.98	0.70

Skewness or sample kurtosis from zero. From the table 7, it can be found that for the variable academic achievement – mean, mode, median is 398.60, 388 and 375 respectively. Standard deviation is 84.36. Skewness values indicate positive skewness with value 0.32. As it is difficult to assume normality form above data, Z value was found for skewness and kurtosis, which is 1.52 and 1.07 respectively indicate that present sample can be considered as normally distributed.

For intelligence variable, represented by 'IQ' - mean, mode median is 102.97, 103, and 100 respectively. It is also interested to note that the most frequently occurred value for Intelligence is 100. It has standard deviation of 8.38. Intelligence is positively skewed with value 0.30 and with kurtosis value 1.22. Z values are 1.46 and 2.92. For Verbal intelligence – VIQ and performance intelligence – PIQ, mean, median and mode are almost equal. It is also interesting to note VIQ scores of data is higher than PIQ. Standard deviations are 10.724 and 9.84 respectively. Both data are positively skewed with values 0.14 and 0.28. Z values are 0.69, 1.10 and 1.32, 7.94 respectively. These values indicate sub variables- VIQ and PIQ are approximately normally distributed. High value of kurtosis for performance IQ is due to outliers in the data. But, z-value of skewness lies within range, so data is assumed to be normal.

Self- regulated learning strategies variable have mean, mode, and median as 160.95, 165 and 153 respectively with standard deviation of 25.56. The data are negatively skewed with value -0.42 and kurtosis value -0.33. Z values are 2.01 and 0.79. So, variable follow normal distribution. For five dimensions of self- regulated learning strategies mean, median and mode are approximately equal. All dimensions

are negatively skewed with values approximately equal to zero. Z values indicating approximately all dimensions falls in normal distribution.

From the above discussions it is evident that all other variables can be assumed to follow normal distribution. So, for investigation parametric tests are used. So, hypothesis 1 of present study is met for variables: Academic achievement, intelligence, PIQ, VIQ, self-regulated learning strategies, and for all five dimensions of SRLS.

Section 2: Relationship between Variables of present research

Strength and direction of relationship between variables - intelligence, verbal IQ, performance IQ, academic achievement, self-regulated learning strategies and relationship with dimensions of Self -Regulated Learning strategies are calculated using Karl Pearson coefficient of correlation. Karl Pearson coefficient of correlation calculates the degree and direction of relationship between variables. Also, the strength and direction of inter relationship between dimensions of self-regulated learning strategies is also found out. Thus, this section is divided into

I. Relationship between main Variables.

II. Relationship between main variables and dimensions of SRLS.

III. Relationship among dimensions of SRLS

I. ***Relationship between main Variables***

Karl person product moment correlation is calculated between variables Academic achievement, intelligence (IQ), Verbal IQ, Performance IQ and SRLS. The coefficient of correlation is presented in the table 8 and also discussed below.

Academic achievement and Intelligence. Based on objective following hypotheses are proposed.

Hypothesis (2.1): There is a significant relationship between intelligence and academic achievement.

Hypothesis (2.2): There is significant relationship between verbal intelligence and academic achievement.

Hypothesis (2.3): There is significant relationship between performance intelligence and academic achievement.

From the table 8, it can be found that all variables are positively correlated. Intelligence and academic achievement have correlation coefficient, r =0.272 i.e. it indicates 7.4 % of positive relationship and significant at 0.01 level. Verbal IQ is not significantly correlated with academic achievement for this sample but performance IQ is significantly correlated with academic achievement with r=0.228, which indicate 5.1 % of relation at 0.01 level. This relationship implies that academic achievement increases with increase intelligence level and a decrease in intelligence (IQ) level can decrease academic achievement. For this sample, Performance IQ which measures abstract and logic intelligence is more related to achievement in school than verbal intelligence which measures vocabulary and factual knowledge.

Table 8

Correlation between Main Variables

Variables	Academic Achievement	IQ	VIQ	PIQ	SRLS
Academic Achievement	1	0.272**	0.160	0.228**	0.722**
IQ		1	0.814**	0.801**	0.196*
VIQ			1	0.356**	0.106
PIQ				1	0.183*
SRLS					1

** Significant at 0.01 level *significant at 0.05 level

Hence, hypothesis that there will be significant relationship between intelligence and academic achievement is accepted. Also, hypothesis that there will be significant relationship between Performance IQ and academic achievement is accepted. While hypothesis that there will be significant relationship between verbal IQ and academic achievement is not accepted.

Significant correlation between intelligence and academic achievement has been confirmed by many studies. Intelligence has been explained as one of the main causes of individual difference in academic achievement. Relationship between intelligence and academic achievement have been well established (Jensen, 1998) and general cognitive ability have been regarded as strong predictor of academic achievement (Gustafsson & Undheim,1996: Neisser et al.,1996). Although there is agreement among researchers that intelligence has positive relation with academic achievement, the magnitude of effect varies from no significant correlation to highly significant correlation (Fisher, 1995; Gottfredson, 2005; Deary, 2007). Noeryanti et

al., (2018) made an attempt to find factors influencing academic achievement. Among many variables selected, intelligence was one variable which could not find any significant relation with Academic achievement through logistic regression analysis. In path analysis through SEM they couldn't get any significant prediction by intelligence. Unfortunately, they did not report their data collection methods. So, more comments couldn't be done. But this result is contradiction to present research were IQ and academic achievement are significantly correlated even though the relationship is below 7%. But their study confirms with present findings that Verbal IQ is not significantly correlated to Academic achievement**.** But there are other studies which found significant strong correlation between these two variables. Kaya et al. (2015) in a comprehensive literature review about intelligence and its relationship with intelligence found there is consensus among researchers that verbal intelligence has stronger correlation with academic achievement than non- verbal intelligence. For present sample Performance IQ is significantly related to academic achievement. This is contradiction to longitudinal study by Naderi et al, (2010). They found intelligence measured by Cattell culture fair intelligence test (best measure of fluid and non-verbal intelligence) were not related to academic achievement for both males and females.

Performance intelligence (non-verbal) ability is described as reasoning ability for novel problem solving and measure potential to learn. Verbal intelligence include ability to analyse language, remembering, understanding information, depend on acquired and accumulated knowledge and predict readiness to learn.

Verbal IQ is not related to achievement in this research may also implies that IQ test is not perfectly standardised for present sample. This is discussed in brief in general observation section (pg.158) of present thesis. It is also concerning that vocabulary level, knowledge level, comprehension skill, arithmetic skill which make up measure for verbal intelligence is not significantly related to achievement at school. In this study measure used to assess academic achievement is Half yearly exam question papers prepared by Kerala board of education 2018 for 10^{th} and 9^{th} std. By reading sample questions it is evident that mere knowledge about different concepts alone not enough to answer these question papers. Abstract reasoning, problem solving ability and logical reasoning are required to answer these questions. Also, overall percentage of relationship between IQ and achievement is also low which usually not the case in other literature studies. These issues have to be researched in detail, particularly in Kerala education system. One of the important factors that has to be kept in mind is IQ test had its origin as predictors of academic achievement. For years and for present, relationship between IQ test scores and achievement scores have been regarded as most important aspect of external or predictive validity (Suwartono, 2018). And contradictory to present finding in an average others research studies show IQ have high correlation coefficient of 0.70 with standardised achievement test and correlation coefficient 0.5 with GPA (Naglieri & Bornstein, 2003).

Academic achievement and Self-regulated learning strategies. Based on the objective, following hypothesis is proposed.

Hypothesis (2.4): There is a significant relationship between academic achievement and self-regulated learning strategies.

From table 8, it is seen that academic achievement is significantly related to self-regulated learning strategies with r= 0.722, which indicate 52% of relationship at 0.01 level of significance. Hence, hypothesis that there will be significant relationship between academic achievement and self-regulated learning strategies is accepted. When student's use of self -regulated learning strategies increases there is increase in achievement at school.

A study in Hong Kong among 15-year olds found SRL is positively related to academic achievement in reading, mathematics, and science. Among all strategies Self-efficacy was found to be strongest predictor (Ho, 2003).

Self-regulated learning strategies and intelligence. Based on objective following hypotheses are proposed.

Hypothesis (2.5): There is a significant relationship between intelligence and self-regulated learning strategies.

Hypothesis (2.6): There is significant relationship between verbal intelligence and self-regulated learning strategies.

Hypothesis (2.7): There is significant relationship between performance intelligence and self-regulated learning strategies

Self-regulated learning strategies is also significantly related to intelligence (see table 8) of the student at r=0.196, and indicate 3.8% of relationship at 0.05 level

of significance. When looked separately for verbal IQ and performance IQ there are very low percentage of relationship which is not significant for verbal IQ but significant for performance IQ. Hence, hypothesis that there will be significant relationship between intelligence (IQ) and self-regulated learning strategies is accepted. While hypothesis that there will be significant relationship between verbal IQ and academic achievement is not accepted. Also, hypothesis that, there will be significant relationship between Performance IQ and academic achievement is accepted.

Most studies between intelligence and SRLS have been conducted in gifted students. Risemberg and Zimmerman (1992), study among gifted students found they use SRLS more spontaneously than non - gifted students. A study by Sontag et al., (2012) using Raven's progressive matrices (RPM) found no relation between intelligence and self-regulated learning. Highly intelligent student didn't prefer self-regulated learning over other forms of learning and preference of self-regulated learning strategy use was similar to normal students. RPM in general measures non –verbal intelligence. But, in present study non-verbal intelligence had significant relation to self-regulated learning strategies, while verbal intelligence had no significant relation to self-regulated strategies.

II. ***Relationship between main variables and dimensions of Self-regulated learning strategy (SRLS)***

Karl Pearson correlation coefficient is found between academic achievement, intelligence (IQ), VIQ, PIQ and dimensions of self-regulated learning strategies such

as motivation regulation, metacognitive regulation, cognitive regulation, behaviour regulation and emotion regulation.

Academic achievement and Dimensions of Self-Regulated Learning Strategy. Under the main hypothesis five other sub hypotheses are formulated. The main hypothesis is as follows**,**

Hypothesis (3): There will be significant relationship between academic achievement and dimensions of self-regulated learning strategies

From the table 9, it is found that there is significant positive relationship between academic achievement and all dimensions of Self-regulated learning strategies at 0.01 level of significance. Highest percentage of relationship is found between cognitive regulation and academic achievement (33.5%) with r=0.579, then nearly equal percentage of relationship between meta-cognitive regulation (33.2%) with r= 0.577. Emotion regulation and Behaviour regulation have 32% and 30.8% percentage of relationship with r=0.566, r=0.555. Least among dimension, yet 28.4% significant relationship was found between motivation regulation and academic achievement with r= 0. 532. Hence, hypothesis there is significant relationship between all dimensions of SRLS and academic achievement is accepted.

Table 9

Correlation between main variables and dimensions of SRLS

Variables	Academic achievement	IQ	Verbal IQ	Performance IQ
Motivation regulation	0.532**	0.202*	0.122	0.183*
Metacognitive regulation	0.577**	0.206*	0.148	0.177*
Cognitive regulation	0.579**	0.209*	0.153	0.186*
Behaviour regulation	0.555**	0.065	-0.013	0.083
Emotion regulation	0.566**	0.27	-0.055	0.044

** Significant at 0.01 level *significant at 0.05 level

Motivation regulation here refers to goal orientation, value given for academic task in order to facilitate learning. And self-efficacy of the student. Peng (2012) found out that motivation regulation (self-efficacy) was significantly correlated to grades and had strongest influence than other self-regulated learning strategies. A study among U.A.E college student's cognitive learning strategies were significantly related to achievement (Albaili, 2006). Ivcevic and Brackett (2014) found emotion regulation ability predicted academic success (measured by rule violation behaviour records, academic recognitions, GPA and honours from school records). Present study implies that metacognitive regulation and cognitive regulation positively related to students' academic achievement. Emotion regulation is also important in student learning as it also positively related to academic achievement. Overall, increase in all dimensions of SRLS increases academic achievement.

Intelligence and Self-regulated learning strategies. Under the main hypothesis five other sub hypotheses are formulated for verbal intelligence,

performance intelligence and intelligence (IQ) separately. The main hypotheses are as follows**,**

Hypothesis (4): There will be significant relationship between intelligence and dimensions of self-regulated learning strategies.

Hypothesis (5): There will be significant relationship between verbal intelligence and dimensions of self-regulated learning strategies.

Hypothesis (6): There will be significant relationship between performance intelligence and dimensions of self-regulated learning strategies.

It seen from the table 9, that intelligence is significantly related to motivation regulation, metacognitive regulation and cognitive regulation with r= 0.202 and r= 0.206 and r= 209 which indicate 4%, 4.2% and 4.3 % relationship at 0.05 level of significance. Performance IQ is also significantly related to motivation regulation, metacognitive and cognitive regulation. Thus, hypothesis that there is significant relationship between Intelligence (IQ) and motivation regulation, cognitive regulation is accepted. But other hypotheses that there will be significant relationship between intelligence (IQ) and other dimensions of self-regulated learning strategies is not accepted. Also, hypotheses that there will be significant relationship between verbal IQ and all dimensions of self-regulated learning strategies is not accepted. Hypotheses that there will be significant relationship between Performance IQ and motivation, metacognition, and cognitive regulation is accepted. While all other hypotheses that there will be significant relationship

between performance IQ and dimensions of self -regulated learning strategies are not accepted.

Intelligence (IQ) is not significantly related to dimensions of self-regulated learning strategies such as, Behaviour regulation, and Emotion regulation. Verbal IQ (VIQ) is not significantly related to any dimensions of self-regulated learning strategies. Yet it is also noted that VIQ have negative relation with emotion regulation and behaviour regulation. It is interesting to note Performance IQ (PIQ) have positive relationship with emotion regulation. Ali Zarei and Azin, 2013 tested among Iranian students which all multiple intelligences predict different dimensions of self-regulated learning. To find out amount of variance in cognitive, metacognitive self-regulated learning that can be accounted for by each of nine multiple intelligences the standardized coefficient in step by step regression model was checked and found that only verbal and existential intelligence predict cognitive regulation strategies and verbal and visual intelligence predict metacognitive self-regulation strategies. These finding and findings from literature review suggest that relationship between intelligence and self-regulated learning strategies vary according to particular cultural, context of education, measurement used for understanding self-regulated learning and particularly, how intelligence is operationalized.

This indicates that for becoming a self-regulated learner, prerequisite of being ‘highly intelligent’ is not required as there is only about 4% of relationship between the same. Any normal person with average IQ level (90-110) can acquire the skill of a self -regulated learner. Significant positive relationship between IQ

with motivation regulation and meta cognitive regulation, cognitive regulation indicates with increase in score of intelligence, motivation regulation, metacognitive regulation and cognitive regulation also increases. Positive significant relationship indicates students scoring high on PIQ also tend to score high on motivation, metacognitive, and cognitive regulation. The important result is non-significant yet negative relationship between VIQ and emotion regulation. These finding imply for a future in depth study on Intelligence and emotion regulation. The non-significant results can also be attributed to issues in standardization of tests. It is briefly described in observation section.

III. ***Relationship among dimensions of SRLS***

Karl Pearson correlation was found between dimensions of SRLS in order to find inter- correlation coefficient between motivation regulation, metacognitive regulation, cognitive regulation, behaviour regulation, Emotion regulation and to analyse how dimensions are distributed in the present sample. The results are presented in the table 10.

Hypothesis (7): There will be significant inter correlation between overall self-regulated learning strategies and dimensions of self-regulated learning strategies

From table 10, it could be observed that all dimensions of Self- regulated learning strategies are significantly inter correlated with each other and significantly correlated to overall self- regulated learning strategies. Metacognitive regulation has the highest percentage of correlation with Self-regulated learning strategies (70.3%)

followed by cognitive regulation (68%). Behaviour regulation and Emotion regulation have 60.9%and 51.5% percentage of relation with SRLS. Lowest relationship is found between motivation regulation and SRLS i.e, 50 %.The frequency of use in any strategies is positively related to Self -regulated learning of the student. Hypotheses that all dimensions are significantly related to Self - regulated learning strategies are also accepted.

Relationship among dimension varies. However, all dimensions have highest correlation with overall SRLS indicate each dimension can be integrated. Also, low correlation with other dimensions when compared to overall SRLS indicate dimensions are discriminant also. Boekaerts (1996) report parallel and reciprocal relationship between components of cognitive and motivational regulation strategies on three levels, goals, domain specific knowledge, and strategy use. The significant correlations among dimensions indicate that SRLS dimensions are not coherent and it can’t be viewed as separate individual components but in terms of coordinated sets of dimensions. How these dimensions should be enunciated to form a coherent picture of SRL is explained through different path models (Howard-Rose & Winne, 1993).

Table 10

Inter Correlation among Dimensions of SRLS

Variable	Motivation Regulation	Meta Cognitive Regulation	Cognitive Regulation	Behaviour Regulation	Emotion Regulation	SRLS
Motivation Regulation	1	0.521**	0.389**	0.386**	0.439**	0.710**
Meta-Cognitive Regulation		1	0.613**	0.598**	0.514**	0.839**
Cognitive Regulation			1	0.627**	0.495**	0.829**
Behaviour Regulation				1	0.444**	0.781**
Emotion Regulation					1	0.715**
SRLS						1

** Significant at 0.01 level

Section 3: Role of socio-demographic variables

The influence of certain demographic variables on academic achievement is analysed

I. Self-regulated learning strategies and sex on academic achievement.

II. Self-regulated learning strategies and class on academic achievement.

I. Self-regulated learning strategies and sex on academic achievement

Hypothesis (8): There will be significant interaction between three levels of self-regulated learning strategies and sex on academic achievement.

The interaction effect of self-regulated learning strategies and sex on academic achievement, two-way analysis of variance was computed. The F value

and mean value are discussed below. The sex has two groups male and female. Self-regulated learning strategies are divided into 3 groups based on 25^{th}, 50^{th} and 75^{th} percentiles as low, moderate and high. Results are given below.

Table 11

Results of Two-way ANOVA of Self-regulated learning strategies and sex on academic achievement

Variable	Main effects		Two way (AB)
	Self-regulated learning strategies (SRLS) (A)	Sex (B)	
Academic Achievement	65.241**	5.600*	0.497

** significant at 0.01 level, *significant at 0.05 level

Table 11 indicates the independent and two-way interaction among Self-regulated leaning strategies (SRLS) and sex on academic achievement. From table 1, it is clear that there exists significant difference in the one-way interaction among variables on academic achievement at 0.01 level of significance. But two-way analysis did not exhibit any significant difference on academic achievement.

Main effects

Main effect clearly points out that independent effect of SRLS and sex on academic achievement. Each variable is discussed separately below.

a) Role of Self-regulated learning strategies on academic achievement.

Table 12

Mean and Standard Deviation of Groups on the basis of Self-regulated Learning Strategies on Academic Achievement.

Variables	Self-regulated learning strategies -SRLS					
	Low (N=33)		Moderate (N=66)		High (N=34)	
	Mean	S.D	Mean	S.D	Mean	S.D
Academic achievement	316.2 [a]	10.08	395.5 [b]	7.2	492.6 [c]	11.08

Note: Different alphabet among Age Group in years denote significant at 5% level using Duncan Multiple Range Test (DMRT)

The entire sample was divided into three groups based on the self-regulated learning strategy score as low, moderate, high groups. Here, the low group represent those who use strategies less frequently than other groups. The mean and standard deviation were calculated with respect to academic achievement. From the results (table 12) it is clear that the group with high self-regulated learning strategies score (N=34) showed significantly higher mean value on academic achievement (492.6). Based on Duncan Multiple Range Test (DMRT), it was found that in academic achievement three groups of SRLS differ significantly. The results indicate that students with different level (low, medium, high) of SRLS have significantly different effect on academic achievement (F=65.2, P,0.01).

There are a handful of researches which substantiate that high self-regulated learners can have high academic achievement. But one important result pertaining to above results were obtained from a study by Valle et al.,(2008). They group students into low, intermediate, and high self-regulated learners. "The results obtained for the differences in academic achievement indicate that there exists a statistically significant positive relation between the SRL and academic achievement. This means that a higher SRL level leads to a higher academic achievement while a low SRL level is connected with lower achievement" (Valle et al.,2008).

b) Sex on academic achievement

Table 13

Mean and Standard Deviation of Groups on the basis of Sex on Academic Achievement

Variables	Self-Regulated Learning Strategies- SRLS			
	Males (N=53)		Females (N=80)	
	Mean	S.D	Mean	S.D
Academic achievement	414.762	9.046	387.858	6.887

The independent effect of sex on academic achievement is also calculated. Table 13 shows that males have high academic achievement than females. The results are significant at F= 5.6 at 0.05 level of significance. This is in contradiction to most studies which report that females are high academic achievers.

Interaction effect

For present study from table 11 it can be seen that there is no significant interaction between self-regulated learning strategies and sex on academic achievement. Thus, the hypothesis that there will be significant interaction between three groups of self-regulated learning strategies and sex on academic achievement is not accepted.

II. Self-regulated learning strategies and class on academic achievement

Hypothesis (9): There will be significant interaction between three levels of self-regulated learning strategies and class of studying on academic achievement.

To analyse the interaction effect of self-regulated learning strategies and class (9^{th} and 10^{th}) on academic achievement, two-way analysis of variance is computed, The F value and Mean values are discussed below.

Table 14 shows that two-way interaction effect of SRLS and class on academic achievement is not significant. Also, no significant independent effect was seen for class. The students do not differ in academic achievement based on which class they are studying in. Significant independent effect was seen for variable Self-regulated learning strategies for three groups. i.e., low, moderate and high. It was discussed in detail in earlier analysis. Now, the hypothesis that there will be significant interaction between three groups of self-regulated learning strategies and class of studying on academic achievement is not accepted.

Table 14

Results of Two-way ANOVA of Self-regulated Learning Strategies and Class on Academic Achievement

Variable	Main effects		Two way (AB)
	Self-regulated learning strategies (SRLS) (A)	Class (B)	
Academic Achievement	65.406**	1.659	0.328

** significant at 0.01 level

Section 4: Self-regulated learning strategies as a mediator

Mediation generally explains the cause of effect of independent variable on dependent variable through mediator variable. Mediator variable is the answer for the question 'why' and 'how' an independent variable predicts dependent variable. If the effect on I.V on D.V is passed through other variables, that variables are called mediator variables. In mediation analysis, *total effect* is the sum of indirect effect and direct effect. *Direct effect* means effect of I.V on D.V. *Indirect effect* - the effect of independent variable on dependent variable transmitted through mediator variable. Indirect effect is calculated by multiplying direct effect of independent variable on mediator (a) and direct effect of mediator on dependent variable (b). Magnitude of indirect effect is amount of mediation. Based on mediation effect it can be partial or complete mediation. In partial mediation I.V have both indirect and direct effect on D.V. In complete mediation I.V variable have no direct effect on D.V, all effects are indirect effect. Mediators can be single mediator or multiple mediators. Direction and magnitude of causal relationship between two variables are

represented through arrow and standard regression coefficients (betas). In Present research effect of SRLS as a single mediator and dimensions of SRLS as multiple mediators is analysed. See figure 12 and 13.

Hypothesis (10): Self-regulated learning strategies shall mediate the relationship between intelligence and academic achievement

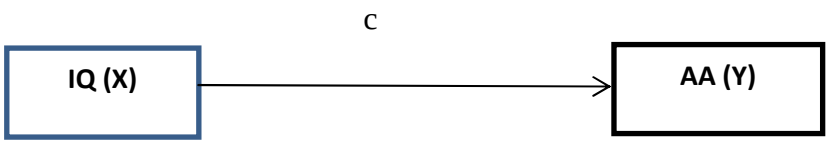

Figure 12. Path diagram of total effect of IQ (intelligence) on AA (Academic achievement).

In multiple regression model using Processes macro v 3.4 (developed by Andrew F Hayes) in SPSS 20 mediation analysis (bootstrapped confidence interval) is carried out. Here, SRLS are operated as a single mediator variable.

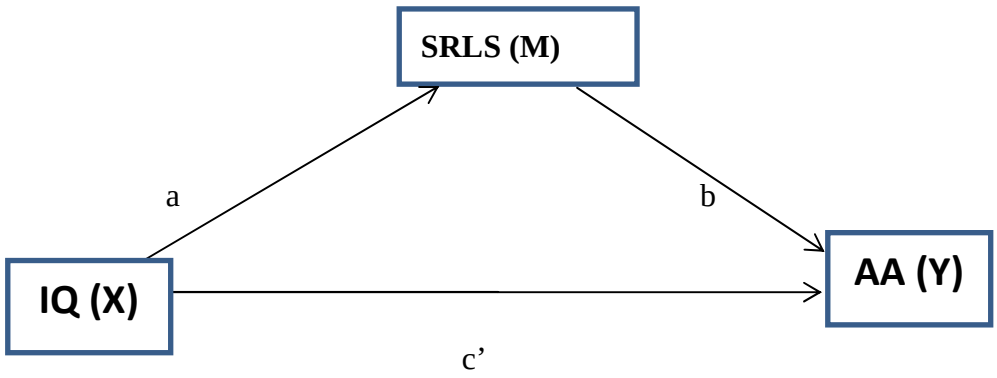

Figure 13. Path diagram of indirect effect of IQ (intelligence) on AA (Academic achievement) through mediator SRLS (Self-regulated learning strategies).

Note: Total effect of IQ on AA is ***c****, Direct effect of IQ on AA is* ***c'****, Indirect effect of IQ on AA through SRLS –* ***a x b****.*

Steps in mediation analysis using processes macro:

1. Confirm the significance of relationship between intelligence and self - regulated learning strategies X →M.(a)

2. Confirm the significance of relationship between intelligence and academic achievement X →Y. (c)

3. Confirm the significance of relationship between self-regulated learning strategies and academic achievement M (X)→ Y (b)

4. Confirm the insignificance of relationship between (or decreased effect) intelligence and academic achievement X(M) →Y. (c')

5. Confirm the significance of indirect effect (After bootstrapping, the upper and lower limit doesn't include zero)

Table 15

Analysis of Mediator Effect of Self-regulated Learning Strategies on Intelligence and Academic Achievement (Total effect, Direct effect, Indirect effect)

Analysis	B	t value	P	BootLLCI	BootULCI
X →M. (a)	0.4658	2.2870	.02		
X →Y. (c)	2.7372	3.2344	.0015		
M (X)→ Y (b)	2.9423	11.4355	<.001		
X (M) → Y (c')	1.3666	2.2342	.027		
Indirect effect	1.3706			0.1846	2.4413

From table 15, it shows that the total effect (c) is the obtained by regressing intelligence on academic achievement without considering SRLS. The regression coefficient for total effect, $X \rightarrow Y$. is c = 2.7372, t = 3.2344 at p=0.0015 level. When intelligence is increased by 1 unit, there is 2.7372 increases in academic achievement. i.e., academic achievement is predicted by intelligence. (Total effect (c)= Indirect effect (a x b) + Direct effect c'). Direct effect of intelligence on academic achievement is about (c') 1.3666 when SRLS is kept constant. Indirect effect of intelligence on Academic achievement is 1.3706 (a x b). The significance of indirect effect tested using bootstrapping procedures. Unstandardized indirect effect was computed for each of 5000 bootstrapped samples. The bootstrap CI is completely above 0, so it is 95% confidence that indirect effect is positive and mediation is significant. The direct effect (c') is reduced from total effect (c), but c' relationship is significant, so self -regulation learning strategies act as partial mediator.

Results from simple mediation analysis can be summarised as that, intelligence is indirectly related to academic achievement through its relationship with self -regulated learning strategies. First it can be seen that more the intelligence, more use of Self-regulated learning strategies by high school students, (a= 0.4658, p=.02). The more self-regulated learning strategies the students apply in their learning process, the more academically achieve they would be, (b=2.9423, p<0.001). A 95% bias – corrected confidence interval based on 5000 bootstrap samples indicated that the indirect effect (a x b=1.3706) was entirely above 0, (0.1846 to 2.4413). More over intelligence predict academic achievement even after

taking into account indirect effect through SRLS (c'=1.3666, p=0.027). Hence, hypothesis self-regulated learning strategies shall mediate the relationship between intelligence and academic achievement is accepted and there is partial mediation.

These are in line with other researches which analysed the mediation effect of SRLS. Online self-regulated learning behaviour act as mediator between positive relationship of online course perception (particularly online communication and collaboration with classmates in online course) and academic achievement measured through grades (Barnard et al.,2008). In a Norwegian sample, self-efficacy, goal orientation and learning strategies mediate the relationship between preceding and subsequent academic achievement (Diseth, 2011). Self-regulated learning had complete mediation effect on the relationship between student learning experience and academic performance (Ning & Downing, 2012). Wolters and Hussain (2015) studied grit – person's trait level perseverance and passion for long term goals and found SRLS mediate relationship between grit and academic outcomes. All of these findings are consistent with most models of self-regulated learning and Pintrich (2004) assumption that SRLS act as mediator between students personal and background characteristics and their performance in particular context (Wolters & Hussain, 2015). The causal relation between cultural characteristics of student, socio-demographic characteristics of student, personality of student, classroom environment, personal characteristics of students and their academic achievement is better explained by self-regulated learning strategies. It indicates that individuals' self-regulation of their cognition, motivation, and behaviour mediate the relationship between the personal, contextual characteristics of student, environmental

characteristics of learning situation and their academic achievement (Pintrich, 2004). In this present research it became evident that SRLS act as partial mediator between intelligence (personal characteristic of student) and academic achievement.

Section 5: Model development through path analysis

Path analysis is mainly preferred because it estimates multiple relationships through single analysis. Path modelling is equated to null hypothesis rather than with alternate hypothesis. Here, power is equated to accept null hypothesis that model is identified with researcher's proposed model. For testing model fit, paths are drawn between constructs intelligence, dimensions of self-regulated learning strategies and academic achievement. In order to arrive at a final model a series of model are analysed. Validity is analysed through criteria of goodness of fit. The goodness of fit indices suggested by RMSEA < 0.08 (MacCallum et al, 1996), CFI ≥ 0.90, SRMR < 0.05 (Hooper et al., 2008). A model is considered good fit if chi square value is insignificant and if incremental fit and badness of fit indices meet predetermined criteria. Holmes-Smith (2006) recommend at least one fitness Index from each category of model fit. Present path analysis followed index suggested by Kline (2005), to report Chi-square model, CFI, RMSEA, SRMR and PNFI.

Path analysis or structural model of SEM is carried out using AMOS 22 version with maximum likelihood estimation. Maximum likelihood estimation assumes normal distribution and usually yields consistent and efficient results. The sample size for path analysis is 133. The maximum number of parameters estimated for path analysis was 22. Based on rule of thumb – 'parameter estimated *5'-, (minimum sample required would be 22*5= 110) (Bentler & Chou, 1987). So, it is

assumed that sample size of 133 is just adequate. A basic model was first prepared. It includes models in which path estimates between dimensions of self-regulated learning strategies and academic achievement is specified. Further modification is carried out until criteria of goodness of fit are met. From these basic models an input model for intelligence predicting academic achievement through dimensions of SRLS is prepared which is then tested for mediation. In path analysis, dimensions of SRLS are acted as multiple mediator variables and are linked sequentially and interconnected, so that indirect effect of IQ (I.V) on academic achievement passes through chain of mediator variables. This indirect effect through multiple mediation is tested through bootstrap method.

Model 1: Relationship between Dimensions of self-regulated learning strategies and academic achievement.

Hypothesis (11): Dimensions of self-regulated learning strategies will have direct effect upon academic achievement.

An input model in which all dimension having direct path to academic achievement and motivation regulation also having indirect path to academic achievement through other four dimensions was first entered. It was found that model wasn't fit only some path coefficients were significant. Figure 14 depict the first input model formed based on a research by Sadi and Uyar (2013) that self-efficacy (sub variable of motivation regulation) had indirect path to academic achievement through sub variables (time management, effort regulation, elaboration etc.) of other dimensions.

This input model 1 (figure 14) doesn't fit the data well, with chi-square value of 142, $p < 0.01$ and CMIN/DF of 20. Model fit indices indicated were GFI=0.692, PNFI=0.274, CFI=0.589, RMSEA=0.383.

So, further modification was made based on factor loadings, modification indices and significant path coefficients obtained from other research studies like Sadi and Uyar (2013),Barzegar (2012) and Kassab et al., (2015).

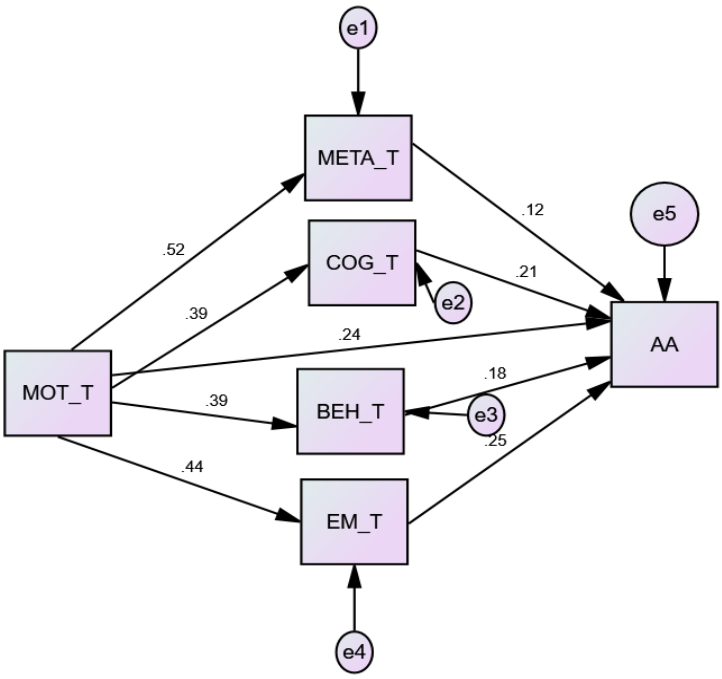

Figure 14. Input model of motivation regulation have direct path and indirect path to academic achievement through, meta cognitive, cognitive, emotion and behaviour regulation.

Note: AA =Academic achievement, MOT =motivation regulations, META = Metacognitive regulation, COG= cognitive regulation, BEH = Behaviour regulation, EM = emotion regulation.

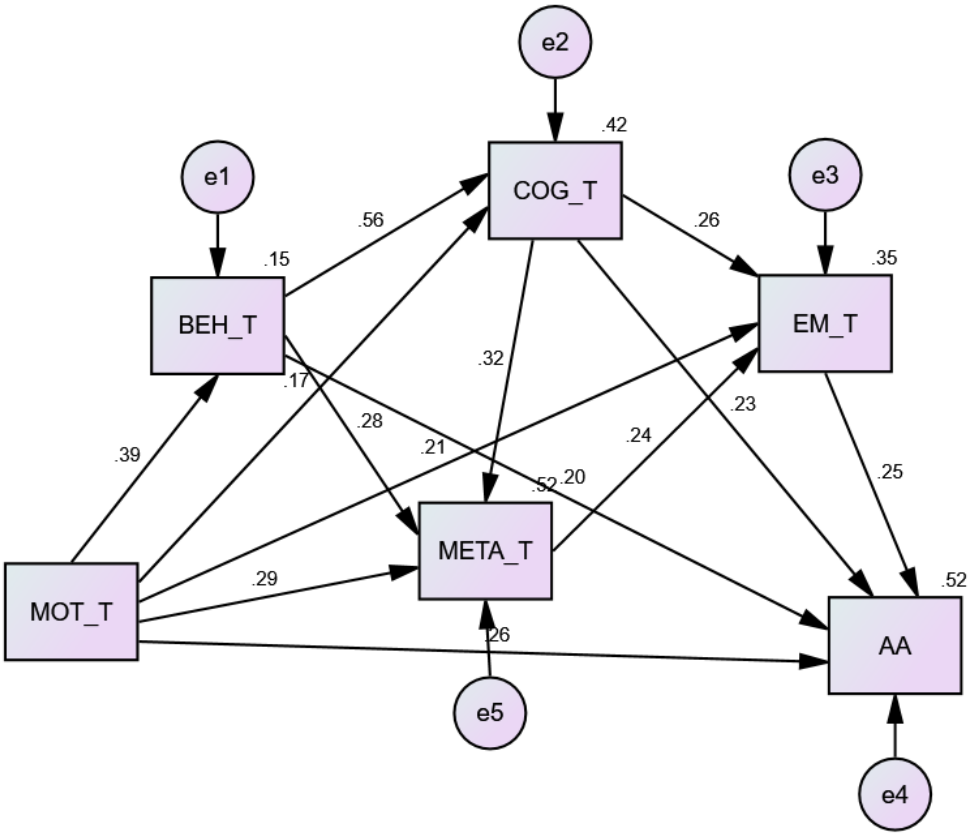

Figure 15: Final model of motivation regulation have direct path to all dimensions, motivation regulation has direct path to academic achievement and indirect path to academic achievement through behaviour regulation, emotion regulation and cognitive regulation.

Note: AA =Academic achievement, MOT =motivation regulations, META = Metacognitive regulation, COG= cognitive regulation, BEH = Behaviour regulation, EM = emotion regulation.

Table 16

Unstandardized Path Coefficient and Standardized Path Coefficients for Path Model of Self-regulated Learning Strategies and Academic Achievement

Variables			Unstandardized Coefficient (B)	Standardised Coefficient (Beta)	P value
BEH_T	<---	MOT_T	.327	.386	<.001
COG_T	<---	MOT_T	.202	.173	0.016
COG_T	<---	BEH_T	.775	.560	<.001
META_T	<---	MOT_T	.273	.285	<.001
META_T	<---	BEH_T	.322	.285	<.001
META_T	<---	COG_T	.265	.324	<.001
EM_T	<---	MOT_T	.155	.209	0.012
EM_T	<---	META_T	.188	.243	0.012
EM_T	<---	COG_T	.167	.265	0.003
AA	<---	MOT_T	3.957	.255	<.001
AA	<---	EM_T	5.285	.252	<.001
AA	<---	COG_T	3.043	.230	0.006
AA	<---	BEH_T	3.698	.202	0.011

Model Fit Indices: $\chi 2 = 2.808$ $p = .024$; GFI = 0.993; RMSEA = 0.055; CFI = 0.998; PNFI = 0.132; SRMR = 0.16.

This final model figure 15, fit the data well, with non-significant chi square value 2.808, df= 2, p=0.24. The model fit indices indicated were GFI=0.993, PNFI=0.132, CFI=0.998, RMSEA=0. 055 and SRMR 0.016.

From this figure 15, it is understood that among dimensions of self-regulated learning strategies motivation regulation strategies have significant direct path coefficients to all other dimensions. It can be interpreted that motivation regulation

is acting like a prerequisite for performing self-regulated learning strategies effectively. Value given by students to tasks, their self-efficacy in doing the task and their goal orientation together predict how regulated students are in other dimensions. Motivation regulation also have a significant direct path to academic achievement.

Cognitive regulation is directly and indirectly affected by motivation regulation. Behaviour regulation shows a significant path way to cognitive, Metacognitive regulation and academic achievement. Cognitive regulation also has direct relationship to metacognitive regulation. Emotion regulation is directly predicted by metacognition and cognitive regulation. Meta cognitive regulation have indirect pathway to academic achievement through emotion regulation. The path coefficients and significance level are shown in table 16.

Hence, hypothesis that dimensions of self-regulated learning strategies will have direct effect upon academic achievement is accepted for motivation regulation, behaviour regulation, cognitive regulation and emotion regulation dimensions. Due to good model fit, this model was used in further testing the mediation role of dimensions of self- regulated learning strategies between the relation of intelligence and academic achievement.

Thus, it can be understood from the model that self-regulated learning strategies dimensions are interconnected concept. Tuckman and Monetti (2011) found out that self-efficacy thought (motivation regulation strategy) will automatically produce feeling or emotions before performance. Believing that there is a chance for success give positive feeling and believing that chance for failure

produce negative emotions and anxiety during performance. Zajacova et al., (2005) report “academic self-efficacy is more important than perceived stress in predicting the accumulation of college credits and a higher GPA”. Students who have high level of motivation regulation strategy will use more cognitive strategies that are useful for them to learn, will organise their time or use effective behaviour regulation strategy and regulate their own effort and thus increase in level of self-efficacy provides confidence to control different academic situations (Alegre, 2014). Studies by Hinton and Fischer (2010) found cognitive, emotional and motivational dimension of learning are interrelated. Gumora and Arsenio (2002) studied early adolescent’s emotion regulation through cross-sectional and longitudinal studies and found emotion regulation significantly predict academic achievement. Researchers (Zimmerman 2011; Sontag, et al, 2012) report that SRL require motivation as a source. The main purpose of a study by Ocak and Yamac (2013) was to determine predictive and explanatory relationship between Self-regulated learning strategies especially, motivational regulation strategies, cognitive and metacognitive regulation strategies. They found that task value, goal orientation, self-efficacy predicted metacognitive strategies and cognitive strategies in a positive way. Alegre (2014) report that motivational and emotional aspects of students are linked in a linear way. If a student has motivation, he/she will find out necessary methods to learn and their performance will be increased and consequently their effort will be reflected in grades. Thus, they specify that more intrinsic motivation bring out more positive emotions.

Mediation Model: Dimensions of self-regulated learning strategies as a complete mediator in relationship between intelligence and academic achievement.

Hypothesis (12): The effect of intelligence on academic achievement will be mediated by dimensions of self-regulated learning strategies.

Intelligence variable was added to final model. A direct path to academic achievement was drawn. A direct path was also connected to motivation regulation (since motivation regulation was found to be having direct path with all other dimensions). This model was tested for mediation using bootstrap method.

Table 17

Unstandardized Path Coefficient and Standardized Path Coefficients for Path Model of Self-regulated Learning Strategies and Academic Achievement

Variables			Unstandardised Coefficient (B)	Standardised Coefficient (Beta	P value
MOT_T	<---	FSIQ	.131	.202	.018
BEH_T	<---	MOT_T	.327	.386	<0.001
COG_T	<---	MOT_T	.202	.173	.016
COG_T	<---	BEH_T	.775	.560	<0.001
META_T	<---	MOT_T	.273	.285	<0.001
META_T	<---	BEH_T	.322	.285	<0.001
META_T	<---	COG_T	.265	.324	<0.001
EM_T	<---	MOT_T	.155	.209	.012
EM_T	<---	META_T	.188	.243	.012
EM_T	<---	COG_T	.167	.265	.003
AA	<---	MOT_T	3.422	.221	.001
AA	<---	EM_T	5.801	.277	<0.001
AA	<---	COG_T	2.422	.183	.024
AA	<---	BEH_T	4.080	.223	.004
AA	<---	FSIQ	1.685	.168	.005

Model Fit Indices: $\chi 2$ = 10.656 p = .010; GFI = 0.977; RMSEA = 0.077; CFI = 0.987; PNFI = 0.277; SRMR = 0.0367.

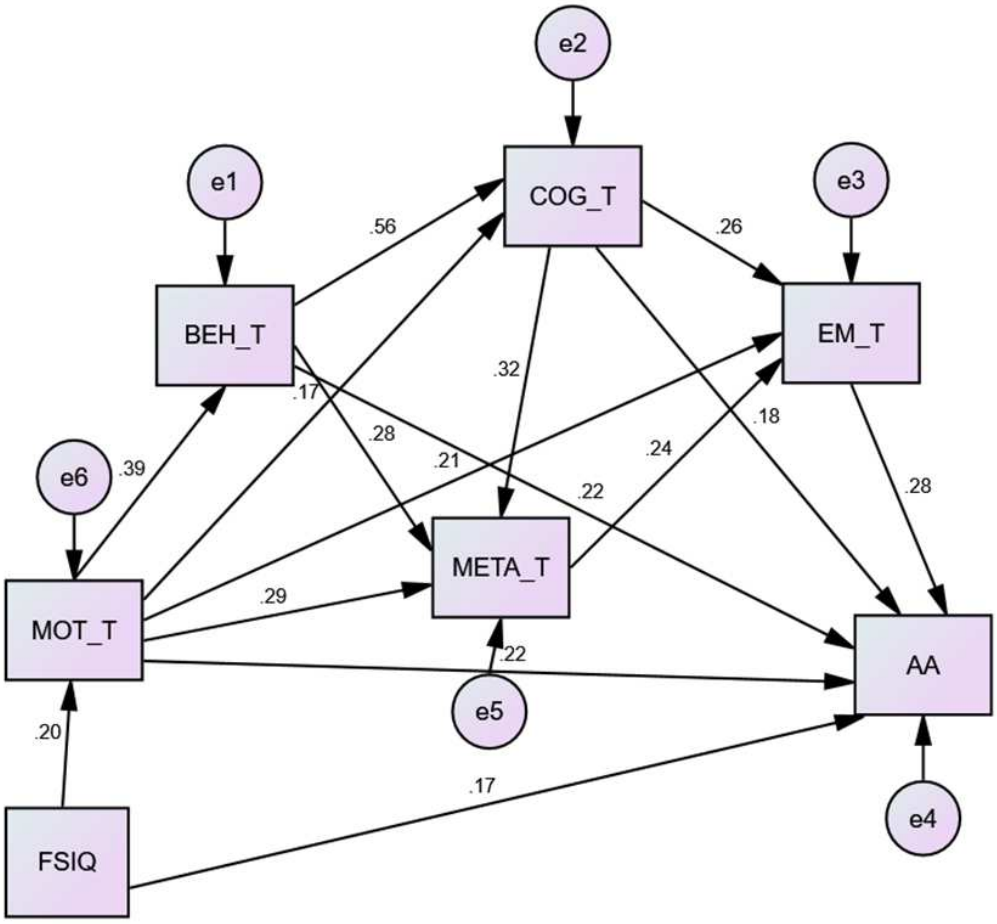

Figure 16. Mediation model of intelligence is partially mediated by dimensions of self-regulated learning strategies.

Note: AA = Academic achievement, MOT =motivation regulations, META = Metacognitive regulation, COG= cognitive regulation, BEH = Behaviour regulation, EM = emotion regulation, FSIQ = Full scale intelligence. (overall Intelligence, IQ)

Table 18

Standardized Indirect Effects - Two Tailed Significance for bootstrap

	FSIQ	MOT_T	BEH_T	COG_T	META_T	EM_T
MOT_T	...	...	...	...	...	...
BEH_T	.027	...	...	...	...	...
COG_T	.028	.001	...	...	...	...
META_T	.030	.001	.001	...	...	...
EM_T	.030	.000	.001	.019	...	...
AA	.034	.001	.001	.001	.023	...

In figure 16, dimensions of Self-regulated learning strategies (SRLS) was found to be partially mediating the path from intelligence (FSIQ) to Academic achievement. As can be seen from the table 17, this model fit the data with non-significant chi square value 10.656, df= 6, p=0.10. The model fit indices indicated were GFI=0.977, PNFI=0.277, CFI=0.987, RMSEA=0.077 and SRMR 0.0367. The direct path from intelligence (FSIQ) to motivation regulation is significant with β=0.202, p = 0.018. Dimensions of SRLS are interconnected in a meaningful way to act as mediator. From table 17 it can be understood that all path coefficients are significant. In this model it can be seen that intelligence also has a direct path to academic achievement with β=0.168, p = 0. 005.

Boostrap was run for 2000 samples in AMOS V22 in order to analyse if the indirect effects were significant. This particular method test for significance of all indirect paths together. From table 18, it can be seen that all p values for indirect effects were significant at 0.05 level.

In a study by Dandy and Nettelbeck (2000) found academic achievement of Australian students from Chinese and Vietnamese background and found IQ underestimated their academic achievements. In primary school children for mathematics grades they found IQ achievement gap, such that Chinese and Vietnamese student scored higher than their Anglo peers who had same ability. From survey it was understood that Chinese and Vietnamese students are more motivated, spent more hours learning and had adequate parental support. (Dandy & Nettelbeck, 2000)

Pajaren and Schunk (2001), their study established that students with high level of self-efficacy get better scores and were persistent in their course than engineering students who had no confidence. Intelligence is necessary but not alone enough for academic achievement, at least there should be motivation regulation as it predict changes in academic achievement. Students who have high belief in their abilities will automatically choose complex and challenging tasks unlike students with low self-efficacy, who tends to avoid them (Shunck & Zimmerman, 1995). Motivation regulation strategies make students self-regulate their motivation for academic learning tasks and determine the time spend with academic learning and behaviour to be adopted in face of challenging tasks (Tuckerman & Monetti, 2011). Emotion regulation strategies refer to conscious way of handling emotions by monitoring, evaluating and modifying emotions. Positive and negative emotions cause load on working memory (Pekrum & Stephen, 2009) and on high cognitive processes like, strategic thinking, problem solving, memory (Pekrum et al., 2006).

This was clarified by Linnenbrink and Pintrich (2000) and reports that load on cognitive resources occur when emotions are not related to task.

From these studies and above result it can be assumed that motivation regulation has a profound role directly and indirectly in determining all other dimensions of self- regulated learning strategies, such that how motivated a student is, determine, their planning, goal setting, rehearsing, elaborating knowledge, help seeking, time planning, environment setting and finally their self-regulation of emotions related to learning. And all of these contribute to academic achievement. It supports the finding from present study that SRLS partially mediate the relationship between intelligence and academic achievement

So, if students have optimal mental abilities/intelligence, but they have appropriate initiation, goal orientation, adequate level of academic efficacy/ expectations, the greater efforts made and more time spend by individual to achieve learning goals, i.e. they engage in metacognitive, cognitive, emotional and behavioural strategy use then there can be better academic performance outcome. As all these regulations can influence academic achievement. Thus, SRLS become an essential determining factor for high achievement. When students have adequate intellectual ability and if they have knowledge about cognitive and metacognitive strategies for learning but low on motivation regulation students will have low confidence to use other strategies as well and when their goals are not directed or oriented and is without value, they can’t organise their learning processes. Thus, resulting in low academic performance and achievement (Alegre, 2014).

To sum up

If an individual is Self-regulated it means he/she has the ability to monitor and maintain emotions, thoughts, and behaviours in ways that are acceptable and produce positive results. Self-regulation has important role in whole areas of human life. A self-regulation study has its importance in all branches of psychology. Education and academic literacy are part of every of society. Academic learning is task were students have to overcome many challenges. So, self-regulation in learning task is a strategy that every student has to learn. There is a belief that intelligence is the determinant of academic achievement. But it is seen that every intelligent student not always achieve academic goal. There can be many reasons, but here, present results propose that the reasons can be difference in level of self-regulated learning.

During high school education, students usually set goals and face different challenges to successfully complete senior secondary examination. To achieve the desired academic goal, it is necessary that students must have adequate intellectual abilities but it is not enough. Intellectual abilities determine student's motivation regulation strategies. Motivation regulation strategies concept try to explain the goal directed initiation, maintenance, and persistence of academic learning behaviour. This includes strategies used to give academic task a value, how the goals are oriented, and self-efficacy beliefs. It is suggested form the model that metacognition strategy like planning, organising and monitoring and cognitive strategies like rehearsal, study tactics will mainly depend on how capable they think they are (Self efficacy), value given for the task and their orientation. Behaviour regulation

changes (seeking help, selecting quiet place for reading, setting time table) bring out cognitive regulation strategies and metacognitive learning strategies like awareness about learning processes. If both strategies are effective it brings out emotion regulation, thus reducing negative emotions. Finally, every regulation process contributes to academic achievement.

Section 6 : General Observation

In this section the discussion surrounds around standardisation issues in IQ test- MISIC (Malin Intelligence Scale for Indian Children), and issues encountered in development of SRLS inventory. There is also an attempt to briefly discuss draw backs in considering scores of examinations as a measure of academic achievement. The arguments presented here is not intended to deny usefulness of IQ tests or deny the use of SRLS inventory for further research studies. This discussion doesn't blindly deny present examination pattern too. It is understandable that clinicians and researchers, students and teachers are using advantage of information obtained on these tests, but the question is how standardised these observations are?

1. MISIC

Present status of MISC as an IQ test

First, an attempt was made to find out whether MISIC is accepted as an IQ test in Kerala.

The evidence was obtained from different sources:

- Right of person with disability (RPWD) assessment guideline recommend MISIC as an IQ test for disability certification. - .Gazette - pg. 94 (Department of Empowerment of Persons with Disabilities, 2018).
- Post-graduation syllabus of 3 (Kannur, Calicut, Kerala) universities of Kerala- include MISC as one of the psychological test in Experimental Psychology Paper.
- M.Phil. clinical psychology students are trained on MISIC
- A survey was conducted by researcher through online platform among 32 practising clinical psychologist asking which IQ tests they commonly used for assessment?
    - It was found that 20 (62.5%) of them uses MISIC as one of the tests for IQ assessment.

Try out

An actual try out using 64 samples were carried out. This step was carried out to observe how each item function in normal population of age 13 years and 1 month to 15 years and 11 months, who were attending Kerala broad English Medium Schools. Samples were selected through convenient and snow ball sampling. Criteria and ethics for data collection were followed. Parental consent was obtained. As all items were administered without discontinue rule and some try outs deviating from standardised test was administered (for e.g. In MISIC, they were asked to orally obtain correct answer for arithmetic items, even if they failed or succeeded, they were asked to do calculations by writing down to know if they

could find solution), it took around two hours per day to complete the test for each sample. The observations are discussed in brief.

Norm

It is evident that it is not fair to a person who is chained for years, is suddenly brought up to starting line of a race and asked to compete. Similarly, it is thought that it is unfair to assess intelligence of children from Kerala with a test that has been validated years back for students of a particular residential school (MISIC norms were formed from students of Hills residential school).

Present children of Kerala would be exposed to educational and living condition at home and at school vary different than years before. Children in 1960 of India might be unfamiliar with testing procedures and materials, which is in sharp contrast with the relatively high level of test wiseness of present Kerala children, who are living in a high-tech era. For example, working with figures and puzzles may be a novel experience for 1960's children, whereas many present children are exposed to these tasks from a preschool level as mobile games and online IQ tests became popularised. There are special android apps to improve memory power, eye hand coordination, reasoning ability, visuo-spatial ability and so on which are freely available in online platform. Malda (2008) reported that "Making puzzles or comparable tasks can positively contribute to one's visual processing ability." Demetriou et al. (2005) in their study on Chinese and Greek children found that Chinese children out performed Greek children on tasks involving visuo-spatial processing and the author's reasoned that it was mainly due to the massive visuo-spatial practice received in learning to write Chinese.

It is also important to keep in mind that main goal of revising intelligence test is for updating norms, MISC was standardised in the year 1969. No updating of norms been reported elsewhere. So, it is concluded that MISIC have inadequate norm. Also, cross cultural suitability of these tests cannot be assumed mainly because of the cultural and educational difference of past and present generation. This suitability is questionable and infrequently studied.

Difference in factor structure of MISIC

In order to check sample size adequacy for performing factor analysis first Kaiser-Meyer-Olkin Measure of sampling adequacy was found, it indicates the proportion of variance in data that may be caused by underlying factors. KMO value above 0.05 indicate usefulness of factor analysis. Bartlett's test of sphericity tests whether the correlation matrix of present sample is an identity matrix and if variables are unrelated, then not suitable for factor analysis. So, a significance value less than 0.05 indicate data is suitable for factor analysis. For present sample KMOP value is 0.687 and Bartlett's significance value is <0.01, it is concluded that data is suitable for factor analysis.

Table 19

KMO and Bartlett's Test for MISIC

KMO value		0.687
Bartlett's Test of Sphericity	Chi-square value	164.043
	P value	<0.001**

Note: ** Denotes significant at 1% level.

Table 20

Factor Loading, Eigen value and Percentage of Extraction using Principle Component Method based on IQ on 11 subtests of MSIC.

Factor	subtests	Factor Loading	Eigen Value	% of Variance	Cumulative %
	Information	0.812			
I	Comprehension	0.853	2.581	23.461	23.461
	Similarities	0.822			
	Digit Span	0.677			
II			1.696	15.414	38.875
	Block Design	0.803			
	Arithmetic	0.647			
III	Vocabulary	0.576	1.437	13.061	51.936
	Coding	0.778			
	Picture completion	0.706			
IV	Object assembly	0.686	1.364	12.400	64.336
	Maze	0.488			

Principal Component Analysis of 11 subtests resulted in 4 factors with subtest Information, Comprehension and similarities as factor 1, Digit Span subtest and Block Design subtest as factor 2, Arithmetic subtest, Vocabulary subtest and coding subtest as Factor 3 and Picture completion subtest, Object assembly subtest and Maze subtest as Factor 4. Several studies had investigated factor structure of WISC series and found varied level of factors. WISC-R have undergone factor analysis in different samples and earned 3 factors- Verbal comprehension,

Perceptual organisation, and Freedom from distractibility. In WISC III a four-factor structure was supported when a subtest symbol search was introduced. The details are in WISC-IV technical manual. A 5-factor obtained for WISC IV when administered to children of neuropsychology clinic (Bodin et al., 2009). Even though a stability for 3 factors hold for WISC III and 4 factor model for WISC-IV was found, across the literature instability in factor structure was found which supported 3 factor, 4 factor or 5 factor model based on population and subtest included.

It is assumed that for present sample four factor structure of MISC would have been more suitable than two factor structure proposed by Malin**.**

Inconsistencies in Arithmetic subtest

Conceptual diversity and debates regarding arithmetic subtest continue in literature. During assessment sample asked to give oral solution to a problem, participants were also asked to write down the problem and find the solution. Number of students who passed the test, is given in a bar chart 1. Majority of sample could answer orally till item number 10 (72%) and the inconsistencies was observed in higher order items. Based on above observation it was assumed that arithmetic subtest is ability to manipulate numbers in mind and find solution, which is really a measure of arithmetic working memory than measuring the quantitative reasoning ability or arithmetic ability. In factor analysis of present sample arithmetic ability was grouped up with vocabulary (measure long term memory and concept knowledge) and coding (also measure working memory and short- term memory capacity, attention, processing speed).

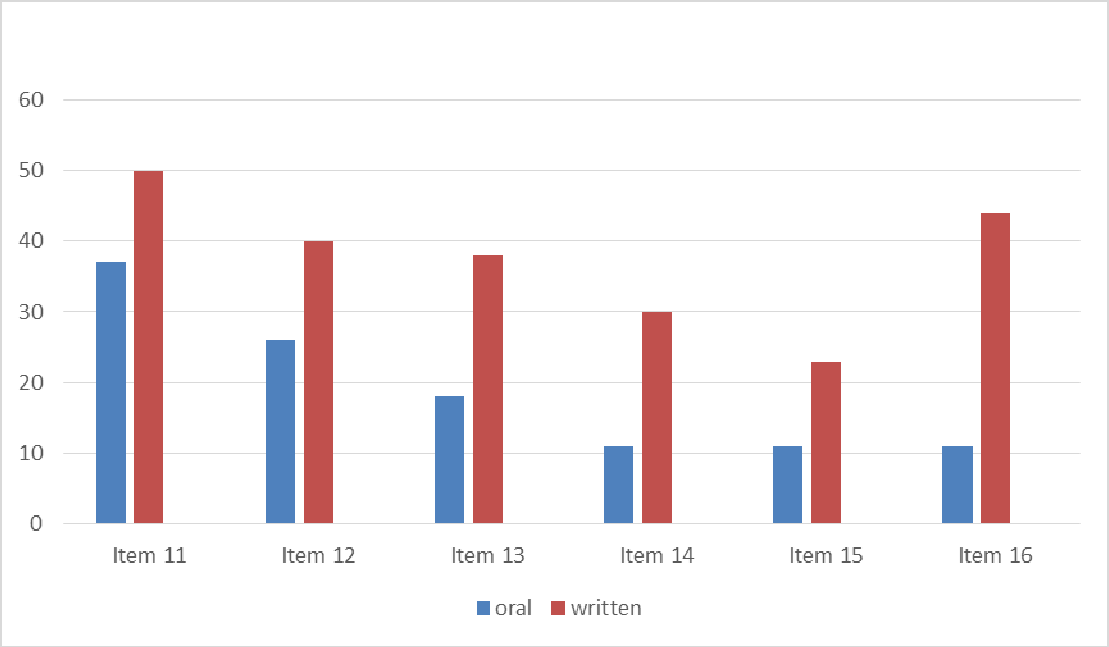

Figure 17. Bar chart of number of samples who passed oral and written arithmetic test from item number 11-16.

Differential item functioning

A major limitation of item bias statistics or indices is that measures of relative difficulty do not provide proof of unfairness. Only if an item is relatively more difficult for one group (statistically biased) and if the source of this difficulty is irrelevant to the test construct then an item is said to be unfair. Holland and Thayer (1988) introduced the term *differential item functioning* to convey this concept more clearly. The study of items that function differently for two groups has a long history. Originally called “item bias” research, modern approaches focus on the fact that different groups of examinees may react differently to the same test question. These differences are worth exploring since they may shed light both on the test question and on the experiences and backgrounds of the different groups of

examinees. It said to occur when examinees from two or more groups have different rate of success on an item. It can occur due to many reasons and one of the main reasons is, item difficulty parameter is different for different groups. It was assumed that items in subtests were arranged in the order of increasing difficulty and percentage of students passing each item decreases as difficulty increases. In all Wechsler scales items within each of the subtests are arranged in increasing order of difficulty, from simple to complex (Camili,2006).

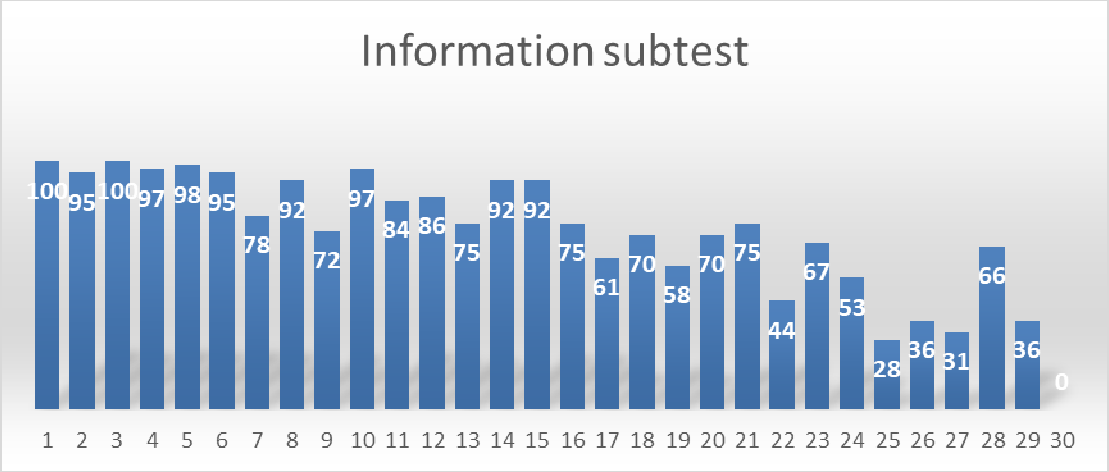

Figure 18. Bar chart of Percentage sample who passed each item in information subtest

Note: X axis- Serial order of items. Y axis total percentage of sample who correctly responded for each item in a sample size of 64

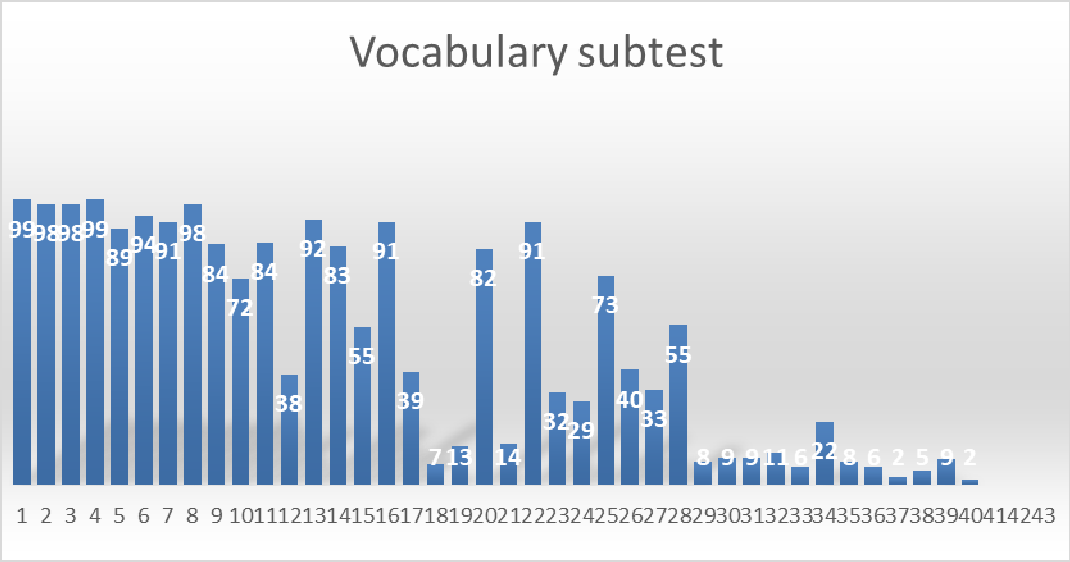

Figure 19. Bar chart of *Percentage sample who passed each item in vocabulary subtest*

In present study pass progression of each item in Information subtest, Vocabulary subtest is depicted in respective bar chart. It was seen that the particular sample did not follow increasing difficulty rule and some lower ordered items are seemed to be more difficult to sample than some higher ordered items. For present sample inconsistency was highly pertained in vocabulary subtest.

Weschler Series of test has been re-normed to compensate for Flynn effect, and the processes is continuing till date. This ensures that norms are up to date and does not result in inflated or deflated scores, but represent current living population. Standardisation procedure also try to make subtest less biased to any categories e.g. females, underprivileged, minorities and they also update materials concurrently to new tech developments. The verbal, non-verbal dichotomy of IQ is buried now, WISC V have 15 composite scores and 4-5 index scores for the clinicians to look up on. Indian testing field have updated the Indian editions parallelly, but the effect is not experienced by the layman.

MISIC was published in the year 1969 and was adapted from WISC edition after its publication in 1949. After that, there have been 4 revisions- WISC R, WISC III, WISC IV, WISC V. Misra, et al. (1997) strongly recommend that Cognitive tests of earlier origin may be inadequate to assess present children. As cognitive tests particularly, MISIC is mainly used for diagnostic purposes and certification. It is important for them to be culturally updated and appropriate. As the experience of a child is bound by his culture and that an intelligence test cannot be equally fair to populations with different upbringings. Consequently, the existing measures of assessment techniques need to be up-to-date and sophisticated. It is high time that research community must propose and illustrate a systematic approach for adapting cognitive instruments to increase their cultural suitability for the target context (Malda,2008).

2. SRLS

Theoretical frame work for developing Self-regulated learning strategies that students may use in 9^{th} and 10^{th} curriculum was based on Zimmerman (1989) and Pintrich et al., (1991) theoretical and conceptual model. But this present framework didn't address a conceptual framework from empirical studies related to self-regulated learning strategies specific to Kerala education system. Problem due to lack of such studies and lack of incorporating such specificity during item construction can be observed while reflecting on items, that were marked for deletion due to specific criteria. These are some of the observations researcher herself made. But surely there can be other explanations too.

Reflections on item deletion. When the deleted items were cross checked with draft, it was interesting to find out more about self -regulated learning construct from a cultural perspective.

1. Item number 11 and 12 were about external motivation regulation thoughts (learning to satisfy family and teacher), in literature it was seen that such thoughts will help one to be self -regulated by acting as external motivator. But for present sample the low self- regulators had such thoughts more often than high regulators, indicating the construct of external motivation is culture specific and have to be deeply studied. It can also be that both items would be acting as social desirability factor for high scorers.

2. Item number 23, 25, 29 and 44 does not discriminate between high and low self- regulated learners, it was also interesting to note that all items are negative items. The items are - Allowing day dreaming in class, loosing marks due to mis-understanding, poor time planning during exams, panicking during exams. Means of both group cluster around 1-2.5, indicating either the item wording should be re written or concepts have to be deeply studied further.

3. Item number 40, 45 and 53 have low correlation with construct as a whole. Procrastinate, high anxiety on eve of exam, losing interest after failing are actually negative items and presence of it actually make students less self-regulated in learning. But it seems these items are less related to self-regulation as a whole. So, these items also demand further understanding.

4. Item number 47 and 49 also show low item total correlation. These are items of futurist thinking (after exam how relaxed I would be) and meditation. These strategies are anxiety reducers and can make one relaxed and thereby help to be more focused. But mean indicate that students (both low and high scorers) are not aware of such methods, they are not performing it. So, it seems that these items function differently in Kerala education system.

5. Item number 41, it was an interesting reflection, as this item indicate a study tactic of, 'writing summary for difficult lesson part'. In literature it was seen that high self- regulated learners use this strategy more often than low self -regulated learners. But in our sample, low group used it more often than high achievers and it was statistically significant (t value was 5.98). The item also has negative correlation with whole construct. As this sample belong to high school group, the content in their syllabus would not be that much cognitive load for students who are high self -regulated learners and possibly they are not applying the strategy of 'summarizing'. Negative correlation indicates it may be acting as a indicator for laziness factor for who score low on self-regulated learning strategies.

Factor analysis

Factor analysis is a method for modelling observed variables and their covariance structure in terms of unobserved variables (i.e., factors). There are two types of factor analyses, exploratory and confirmatory.

Present research chooses EFA than a PCA (principal component analysis). Both methods try to reduce the dimensionality of the data set down to fewer unobserved variables, but whereas PCA assumes that common variance takes up all of the total variance, common factor analysis assumes that total variance can be partitioned into common and unique variance. For present research is (if simply reduce variable list down into a linear combination of smaller components – then PCA) it is assumed that there is a latent construct that defines the interrelationship among items. Exploratory factor analysis (EFA) is a method to explore the underlying structure of a set of observed variables, and is a crucial step in the scale development process (Introduction to SPSS).

Guide line provided by Cabrera-Nguyen (2010) also suggest that it's better to do common factor analysis as a precursor to CFA than a principal components analysis. After refining the item pool and finding out underlying factor structure, CFA can be followed using a different sample to confirm EFA – informed priori factor model.

As from theory it was hypothesised that there would be five dimensions, the extraction was restricted to 5 factors, using Maximum likely hood estimate. Since, it was hypothesised that factors were correlated Promax rotation was choose to arrive at a simple structure.

Table 21

Exploratory Factor Analysis of Self-regulated Learning Strategy

Items	Factor				
	1	2	3	4	5
HS35	0.669				
REHR65	0.608				
REG21	0.587				
REHR64	0.584				
PL22	0.568				
ER48	0.458				
TM43	0.439				
PL18	0.396				
HS34	0.393				
ORG56		0.618			
REHR68		0.563			
ORG41		-0.484			
REHR66		0.451			
ORG42		0.406			
REG24		0.387			
ORG57		0.38			
SR33		0.345			
PL19		0.337			
ELAB58		0.323			
TV17			0.623		
SE13			0.575		
REG26			0.529		
SE7			0.521		
REHR67			0.445		
ER46			0.443		
ER51			0.369		

Items	Factor				
	1	2	3	4	5
ELAB60			0.333		
TV15			0.313		
ER38				0.618	
TM36				0.616	
ORG55				0.594	
ER39				0.515	
MON28				0.491	
TM37				0.472	
ELAB61				0.343	
ES32				0.333	
GO5					0.609
SE14					0.577
TV6					0.563
TV2					0.516
GO9					0.487
MON20					-0.409
MON27					0.334

Extraction Method: Maximum Likelihood.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 21 iterations.

The final structure yields a good model with five factors. But it was difficult to find a common underlying latent construct behind the items that formed a factor. The result though convincing actually gave a messy EFA. At this point it can be decided that items can be rewritten and sampling can be recollected. But such steps were not practically feasible for a doctoral research with test construction only a secondary aim.

Cabrera-Nguyen (2010) while giving guidelines for scale development and reporting, have the opinion that guidelines limited to latent variable approach have little consensus in the literature and some aspects are debatable. So, these guidelines of CFA after EFA are only frameworks.

Scale development and validation using EFA and CFA is a complex process involving many choices regarding (a) data screening procedures; (b) model fit statistics; (c) statistical tests for comparing competing models; and (d) the next appropriate step in the scale development and validation process. It is difficult to develop a decision tree that adequately specifies the entire universe of choices. Authors should use these guidelines as a roadmap, but they should also be familiar with ongoing developments and debates in the psychometric literature (Cabrera-Nguyen,2010).

Kline (2005) recommended a suggestion to the problem EFA v/s CFA. i.e., researchers must not overinterpret and do not reify to CFA after EFA. EFA is not based on a priori hypothesis, but there are confirmatory models in EFA e.g., specifying the number of factors to be extracted. Similarly, CFA is not strictly confirmatory. In many analysis -

> Researchers first specify the model and after the model is tested the researcher can review the results and there for modify the model if necessary, to find a new one that may be a better fit for the data .One of the special aspect of CFA is that if a new model is specified and tested, the new results can be statistically compared with the initial results to determine which model fits the data best. (Miller & Lovler, 2016)

These re-specifications must be guided by theory. Thus, relatively few applications of CFA are strictly confirmatory. In reality, researcher can have a hypothesised model and then can also have other models for comparisons. For e.g., one factor or two factor or three factor model and find out which one fits the data well.

Kline (2005) advice that if a model is retained in EFA then its is not advisable to conduct CFA as a follow up analysis after EFA. The best method recommended is to replicate the results of EFA is by collecting more data and replicate same method in replication sample. Osborne and Fitzpatrick (2015) report procedures for evaluating EFA results for same variables replicate over independent samples.

Based on above reviews it is assumed that research can use either EFA or CFA, but not necessarily both methods. While, EFA followed by CFA is one of the most common approaches to scale development and validation. It's better to use right tool for right job and authors can provide an empirically based rationale for their choice of a particular approach (Kline, 2005; Cabrera-Nguyen 2010).

3. Academic achievement

Academic achievement is a general term usually representing the performance of students in an educational institution. In present study and in Kerala educational system it is defined mainly based on intellectual domains. Even though co -curricular activities are encouraged, field such as music, sports, dance, literature writing skills for which certain motor and creative abilities are more important are

usually excluded. Even though academic achievement is the most important predictor of jobs and higher education, it has only modest association with life success or higher life satisfaction (Spinath,2012). In present study academic achievement is the arithmetic mean of all subject scores that have been received for half yearly examination. But based on some ideology, there are researchers who question whether teacher's evaluation and teacher rated score actually measure student's performance, how much reliable and valid the scores are. Despite this known and assumed distortions (such as positive or negative attitude towards a student, knowledge on how much effort a student may have involved etc.) of grades due to teacher's subjective evaluation, researchers often take scores or GPA as measure of academic achievement. They reason, by assuming academic marks are "highly aggregate scores of performances collected from different teachers on different subjects". In some researcher's report validity of academic scores are advanced by their stronger association with standard achievement tests and correlation usually lies between r = 0.50 to 0.70. Another strong evidence for validity of grades can be obtained from prediction of future success in academic domains (Spinath, 2012). But "there is no general agreement on how it is best evaluated or which aspects are most important—procedural knowledge such as skills or declarative knowledge such as facts" (Spinath, 2012). For present study it was difficult to administer a standard achievement test and as this study was of cross-sectional nature future prediction could not be obtained.

These observations also call for new avenues of research in the field of test development - albeit differently.

Chapter 6

Summary and Conclusion

- **Summary of Research**
- **Major Findings of the Research**
- **Implication of Research.**
- **Suggestion and Limitation of Research**

Almost one third of an individual's life is spent in educational institution. Success in school plays an important role in impacting students' future opportunities, making some choices more likely and eliminating others. Apart from family, school environment and academic experience have seminal role in success of individual. In all educational institutions, the whole teaching learning process is directed towards achievement in the academic field as well as in the sphere of co-curricular activities. The academic achievement is required to be of greater value and for the attainment of which the students, teachers and parents strive towards it. A myriad of factors has been identified as being related to academic achievement, the two of most fundamental of which will be intelligence and self-regulated learning.

Self-regulated learning is a multidimensional construct and attempt to explain reason for students' academic achievement or the lack of it. From research studies a number of variables can be gathered that may influence academic achievement – goal orientation, planning, metacognitive strategies, attributions, making deliberate changes in the environment, cognitive rehearsal, effort regulation, help seeking, and so on which have been found to be high in self-regulated learners. These variables are grouped into different dimensions such as motivation regulation strategies, cognitive regulation strategies, behaviour regulation strategies, emotion regulation strategies, and metacognitive regulation strategies. A self-regulated learner is always active in making use of these dimensions by applying different strategies for learning. Zimmerman (2000) define it as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of

personal goals". For a self-regulated learner these personal goals would be related to school success and academic success and tasks related to it. The most widely cited and accepted definition of Zimmerman (1986;1989) is "self-regulated learning is the ability to be meta-cognitively, motivationally, and behaviourally active participants in the learning process". Meta-cognitively, self-regulated learners plan, organize, self-instruct, self-monitor, and self-evaluate at different stages as they learn. Motivationally, they perceive themselves as competent, self-efficacious, and autonomous. Behaviourally, they select, structure, and create their environments for optimal learning.

Several different theoretical models explain self-regulated learning from different perspective and give emphasise to different dimension but all have a common objective to describe how students can become a responsible learner by regulating their motivation, meta-cognition, cognition, emotion and behaviour and there by regulating their learning and performance. Thus, this construct view students as responsible learners. For present research self-regulated learning strategies is operationally defined as "motivational, cognitive, meta cognitive, behavioural, and emotional strategies practised by students to become a self-regulated learner". This definition is similar to Zimmerman's but have included emotion regulation – a construct not well explored by Zimmerman but emphasised well by others like Bekaerts (Boekarts & Corno, 2005).

Based on the reviews relating to intelligence and academic achievement, the empirical support for direct influence of intelligence on academic achievement is seen as promising but not conclusive. There are however, some concerns regarding

influence of other variables, in their relationship, such as personal characteristics (self-efficacy, motivation, emotion regulation capacity, etc.), school related variables, variables related to family structure and relationship among family members. Among them regulation of personal characteristics for academic learning can together be called as self-regulated learning and has become one of the newly and widely explored construct, especially the mediating role of self-regulated learning strategies in various relationships. So present study investigates the mediating role of self-regulated learning on relationship between intelligence and academic achievement and the study is entitles as "**The Intricate Relationship Between Intelligence and Academic Achievement: Examining the Role of Student's Self-Regulated Learning Strategies".**

Objectives of the research

Part I

1. To examine the relation between intelligence, self-regulated learning strategies, and academic achievement.
2. To examine the relationship between sub variables of intelligence, academic achievement, and dimensions of self-regulated learning strategies.
3. To analyse the role of socio-demographic variables
4. To find out the mediating effect of self-regulated learning strategies on relationship between intelligence and academic achievement.
5. To examine pathways of dimensions of self-regulated learning strategies on academic achievement.

6. To examine pathways of intelligence through dimensions of self-regulated learning strategies on academic achievement.

- To study the mediating role of dimensions of self-regulated learning strategies on academic achievement and intelligence

Objective of Observation

1. To critically analyse tools used for present study

Hypotheses of the Study

The hypotheses formulated for present research based on objectives described.

Descriptive analysis

1. The sample data are not significantly different than a normal population.

Inferential analysis

2. There will be significant relation among main variables under study.

2.1) There is a significant relationship between intelligence and academic achievement.

2.2) There is significant relationship between verbal intelligence and academic achievement.

2.3) There is significant relationship between performance intelligence and academic achievement.

2.4) There is a significant relationship between academic achievement and self-regulated learning strategies.

2.5) There is a significant relationship between intelligence and self-regulated learning strategies.

2.6) There is significant relationship between verbal intelligence and self-regulated learning strategies.

2.7) There is significant relationship between performance intelligence and self-regulated learning strategies.

3) There will be significant relation between academic achievement and dimensions of self-regulated learning strategies

3.1) There is a significant relationship between academic achievement and motivation regulation

3.2) There is a significant relationship between academic achievement and meta-cognition regulation

3.3) There is a significant relationship between academic achievement and cognition regulation

3.4) There is a significant relationship between academic achievement and behaviour regulation

3.5) There is a significant relationship between academic achievement and emotion regulation.

4) There will be significant relation between intelligence and dimensions of self-regulated learning strategies

4.1) There is a significant relationship between intelligence and motivation regulation

4.2) There is a significant relationship between intelligence and meta-cognition regulation

4.3) There is a significant relationship between intelligence and cognition regulation.

4.4) There is a significant relationship between intelligence and behaviour regulation.

4.5) There is a significant relationship between intelligence and emotion regulation.

5. There will be significant relation between verbal intelligence and dimensions of self-regulated learning strategies

5.1) There is a significant relationship between verbal intelligence and motivation regulation.

5,2) There is a significant relationship between verbal intelligence and meta-cognition regulation.

5.3) There is a significant relationship between verbal intelligence and cognition regulation.

5.4) There is a significant relationship between verbal intelligence and behaviour regulation.

5.5) There is a significant relationship between verbal intelligence and emotion regulation.

6. There will be significant relation between performance intelligence and dimensions of self-regulation.

6.1) There is a significant relationship between performance intelligence and motivation regulation.

6.2) There is a significant relationship between performance intelligence and meta-cognition regulation.

6.3) There is a significant relationship between performance intelligence and cognition regulation.

6.4) There is a significant relationship between performance intelligence and behaviour regulation.

6.5) There is a significant relationship between performance intelligence and emotion regulation.

7. There will be significant inter correlation between overall self-regulated learning strategies and dimensions of self-regulated learning strategies

7.1) There is a significant relationship between overall self-regulated learning strategies and motivation regulation

7.2) There is a significant relationship between overall self-regulated learning strategies and meta-cognition regulation

7.3) There is a significant relationship between overall self-regulated learning strategies and cognition regulation

7.4) There is a significant relationship between overall self-regulated learning strategies and behaviour regulation

7.5) There is a significant relationship between overall self-regulated learning strategies and emotion regulation.

8. There will be significant interaction between three levels of self-regulated learning strategies and sex on academic achievement.

9. There will be significant interaction between three levels of self-regulated learning strategies and class of studying on academic achievement.

Mediator analysis

10. Self-regulated learning strategies shall mediate the relationship between intelligence and academic achievement.

Path model for academic achievement, following hypotheses was proposed.

11. Dimensions of self-regulated learning strategies will have direct effect upon academic achievement.

12. The effect of intelligence on academic achievement will be mediated by dimensions Self-regulated learning strategies.

Method

Researcher made use of correlational design from quantitative perspective. Different analysis techniques were used for analysis of results. Also, a critical analysis was conducted on tools used for data collection, namely MISIC, SRLS and Exam Score.

Participants

The population of this study consists of high school students of Kerala state who follows Kerala board English medium education. Samples consisted of 133 high school students of Kerala between the ages ranging from 13-15 years.

Measures used

- MISIC – Malin's Intelligence Scale For Indian Children
- SRLS-Self Regulated Learning Strategies
- Academic Score Sheet
- Socio Demographic Data Sheet

Procedure

After getting the permission from head masters of different schools, a detailed description about the study was explained to the whole class. Students were informed that study was not part of academic syllabus and participation was voluntary and confidentially was asserted. A list of students willing to participate was created. From that list through lottery method students were selected. Students were given IQ tests; self-regulated learning strategy inventory and personal data were collected using socio demographic data sheet. The administration was done individually in the room provided by the schools. Informed consent was obtained from parents. Academic score collected from school records.

Statistical analysis

Appropriate statistical techniques are used according to the objectives of the study, such as descriptive statistics, correlation and analysis of variance, and

mediator analysis using processes macro. Finally, path analysis was carried out for different model in Amos V.22. Input models were selected based on model fit and finally a model confirmed for partial mediation of dimensions of self- regulated learning was selected.

Tenability of the hypotheses

Based on objectives of research different hypotheses were formulated and tested.

In order to study the effect of intelligence, its sub variables, self-regulated learning strategies and its dimensions on academic achievement of the high school students of Kerala, following hypotheses and the sub hypotheses are formulated and tested.

The first hypothesis states: there will be normality on the nature of distribution of the variables, intelligence, self-regulated learning strategies and academic achievement.

The values from the measures of the central tendency, mean, median, mode, skewness and kurtosis for the variables were found to be not much deviated from normality and met the conditions of normal distribution. Thus, the hypothesis is established.

The second hypothesis proposes: there will be significant relationship between the main variables, intelligence, self-regulated learning strategies and academic achievement

Correlation analysis is carried out to test the hypothesis and the hypothesis

was classified in to seven sub hypotheses.

a. **There is a significant relationship between intelligence and academic achievement.**
b. **There is significant relationship between verbal intelligence and academic achievement.**
c. **There is significant relationship between performance intelligence and academic achievement.**

All variables of intelligence were positively correlated with academic achievement but significant relationship was obtained for intelligence and performance intelligence. Thus, two (a, c) hypothesis is established. But the hypothesis there is significant relationship between verbal intelligence and academic achievement wasn't established. So, the hypothesis is restated as, there is no significant relationship between verbal intelligence and academic achievement.

d. **There is a significant relationship between academic achievement and self-regulated learning strategies.**

A significant correlation was obtained for self-regulated learning strategies and academic achievement. Hence hypothesis is accepted.

e. **There is a significant relationship between intelligence and self-regulated learning strategies.**
f. **There is significant relationship between verbal intelligence and self-regulated learning strategies.**

g. There is significant relationship between performance intelligence and self-regulated learning strategies.

Intelligence and performance intelligence had significant relationship with self-regulated learning strategies. So, only the hypothesis (e and g) is accepted and other hypothesis that verbal intelligence have significant relationship with self-regulated learning strategies is not accepted. So, the hypothesis is restated as there is no significant relationship between verbal intelligence and self-regulated learning strategies.

The third hypothesis proposes: there will be significant correlation between academic achievement and dimensions of self-regulated learning strategies.

All five dimensions of self-regulated learning strategies are significantly correlated with academic achievement. So, hypotheses were established.

The fourth hypothesis states: there will be significant correlation between intelligence and dimensions of self-regulated learning strategies.

Intelligence and Performance intelligence is significantly correlated with motivation regulation and cognitive regulation meta cognitive dimensions. Verbal intelligence not significantly related to any dimensions. So, the hypothesis was proven to an extend only.

The fifth hypothesis states: there will be significant inter correlation between overall self-regulated learning strategies and dimensions of self-regulated learning strategies.

All dimensions of self-regulated learning strategies have significant

relationship with each other and also with overall self-regulated learning strategies. So, hypothesis is established.

The sixth hypothesis states that there will be significant interaction between three groups of self-regulated learning strategies and sex, class of studying on academic achievement.

The interaction effect of sex and class with different levels of self-regulated learning strategies were also found out. But no significant interaction effect was found. So, hypothesis restated as There will be no significant interaction between three levels of self-regulated learning strategies and sex on academic achievement and There will be no significant interaction between three levels of self-regulated learning strategies and class of studying on academic achievement.

To examine the mediator effect of self- regulated learning strategies between intelligence and academic achievement; the following hypothesis are tested.

Self-regulated learning strategies shall mediate the relationship between intelligence and academic achievement.

Mediation analysis using processes macro was conducted to analyse the mediation effect of self-regulated learning strategies in the relationship between independent variable- intelligence and dependent variable -academic achievement. So, the following hypothesis is tested.

A) Self-regulated learning strategies can mediate the relationship of intelligence and academic achievement.

Mediator analysis using processes macro make use of bootstrap analysis in

order to test if the variable act as mediator. A 95% bias – corrected confidence interval based on 5000 bootstrap samples indicated that the indirect effect (ab=1.3706) was entirely above 0, (0.1846 to 2.4413). Moreover, intelligence predict academic achievement even after taking into account indirect effect through SRLS (c'=1.3666, p=0.015). Hence, hypothesis self-regulated learning strategies shall mediate the relationship between intelligence and academic achievement is accepted and there is partial mediation.

In order to test whether different dimensions of self -regulated learning strategies mediate relationship between intelligence and academic achievement a path model was developed step by step.

B) Path model for academic achievement

Motivation regulation, Cognitive regulation, Behaviour regulation and Emotion regulation dimensions of self-regulated learning strategies have direct effect upon academic achievement and Metacognitive regulation have indirect effect. Motivation regulation has direct relationship to all other dimensions. The effect of intelligence on academic achievement is partially mediated by dimensions of self-regulated learning strategies.

Major Findings of Research

1) Self-regulated learning strategies and academic achievement are strongly related to one another

2) As motivation regulation is effectively functioning in a high school student then chances that academic achievement will be high for such individuals.

3) Other dimensions of Self-regulated learning strategies such as meta cognitive regulation, cognitive regulation, behaviour regulation and emotion regulation also contribute positively for academic achievement.

4) Intelligence has got very weak positive relation with academic achievement in current sample of high school students.

5) For present sample of high school students, performance IQ which measures abstract and logic intelligence is more related to achievement in school than verbal intelligence which measures vocabulary and factual knowledge.

6) The relationship between self-regulated learning strategies and intelligence was also found to be very weak, indicating self-regulated learning strategies are more trainable for high school student with average level of intelligence.

7) There is difference in academic achievement of high school student based on in which group they belong to i.e., low, moderate or high self-regulated learner.

8) For present sample males had high academic achievement than females.

9) For, present sample, in which class (9^{th} or 10^{th}) high school students are studying, doesn't influence their academic achievement.

10) Self-regulated learning strategies found to have a mediating role in relationship between intelligence and academic achievement.

11) Model 1, Motivation regulation have direct path to all dimensions, motivation regulation has direct path to academic achievement and indirect

path to academic achievement through behaviour regulation, emotion regulation and cognitive regulation.

12) Mediation Model, IQ have direct path way to academic achievement, and indirect path way through dimensions of self-regulated learning strategies. Thus, dimensions of Self-regulated learning strategies act as partial mediator.

Findings from General Observation

While administering MISIC to participants a common pattern of issues and difficulties were noted, which was later developed into a research question- "is MISIC accountable as an IQ test for present population of Kerala?" For finding the standardisation issues in MISIC, it was administered to 64 high school students. Major findings were:

1. MISIC forms part of the syllabus of post graduate and MPhil courses, is administered by clinicians and used for disability certification.

2. Norms are inadequate, especially in terms of generation sensitivity

3. A four-factor structure was obtained for factor analysis of MISIC subtests.

4. Inconsistencies in arithmetic subtest.

5. Differential item functioning identified for information subtest, vocabulary subtest.

6. EFA and CFA of Self-regulated learning strategy inventory gave different suggestions on factor structure of the test. So, it suggests that researchers must be cautious in using right tool for right job. Also, now it is reported that

division between EFA and CFA is fading out. New researchers are being carried out based on 'EFA within a CFA framework'.

7. Academic achievement, despite the short coming that it measure only factual knowledge, is globally and widely indicated through Exam scores.

Implications of research

The present research was designed to understand and find out the relations between intelligence and self-regulated learning strategies in predicting academic achievement. A large number of literatures have studied the relationship between intelligence with academic achievement and self-regulated learning strategies with academic achievement separately. But present research examined the mechanism by which dimensions of self-regulated learning strategies is related to intelligence and academic achievement. This is the first study that attempt to analyse the effects of these three variables in an integrated system. Present research has tried to integrate the different models of self-regulated learning in a coherent framework and also developed tool for assessment. This study identified different dimensions of self-regulated learning as one way in which intelligence influence academic achievement.

Lack of self-regulated learning strategies can contribute to students' underachievement. Teachers can help student to develop set of productive behaviours that affect students' learning, thus, successfully increasing students' self-regulation and enhancing academic achievement. Students who are self-regulated learners is excepted to be successful in academic life because they will have a control over their learning processes by directing and regulating their actions. It is

hoped that present research would emphasise the need to promote self-regulated learning among students, the need for training teachers, so that they could efficiently direct students to use appropriate self-regulated learning strategies and executing various interventions to enhance the use of self-regulation strategies to reverse underachievement in students.

Observation part of present research also encourages professionals to question the credibility of IQ tests they regularly use. It also emphasises how an intelligent test should be developed and inspire 'Intelligent administration of Intelligence Test'. It also observes the issues in test construction and standardisation, especially the issue of statistics vs theoretical judgment in psychological construct. Emphasis of academic and education community on scores obtained as a goal of academic achievement is also questioned.

Suggestions and Limitations of Research

Present research has focused on self-regulated learning as an aptitude measure – as a self-reported theoretical construction and measured through a quantitative questionnaire method – students report strategies that they intend or remembered to apply in their learning or report how they learn or regulate their learning. Since, only few explorations have been done in Kerala system of education about self-regulated learning it would be more informative to use a qualitative method and learn about self-regulated learning as a 'process' in future researches. In a process's definition of self-regulated learning the group of actions that the students deploy in a current task is measured. In a qualitative approach, usually by interview

the students can freely talk about the strategies they usually apply. Thus, more can be understood about self-regulated learning from a current educational perspective.

There are also other literature studies (Wirth & Leutner, 2008) which emphasise that it is not frequency of strategy use lead to academic achievement but the quality of implemented strategy lead to beneficial learning. Thus, the competency of self-regulated leaner to appropriately regulate learning processes can be explained through three approaches, a) processes approach- were emphasis is to temporal and cyclic phase of self-regulated learning, b) strategy approach- were emphasis is on motivational, cognitive, metacognitive and resource-oriented strategies applied for learning, c) knowledge approach- were emphasis is on procedural, declarative knowledge. In this research the focus is on second approach strategy approach. Here, SRL is conceptualised and measured using questionnaire applying the concept that the more self-regulated the learner is the more strategy use and can lead to increased academic achievement. But there is also other conceptualisation that, fit between strategy applied and specific learning situation and task is crucial for being a good self-regulated learner. More research has to be conducted in that area and through other approaches.

Emotion regulation addressed in this research mainly focuses on negative emotion especially on boredom and test anxiety alone. The concept has to be developed more by incorporating interest and enjoyment, curiosity, shame, pride, confusion, student response to teacher emotions that students experience in classroom setting and how regulation of these emotion contribute to student academic achievement.

The current research is considered as an initial attempt to explore self-regulated learning in Kerala syllabus English medium high school students. Future studies can incorporate different methods and perspectives to study self-regulated learning and can also include other factors which may influence self-regulated learning, so that a coherent view of mechanism can be understood. More factors which may influence academic achievement can also be included to know how self-regulated learning interact with them. Also, longitudinal studies are recommended. A similar study can be conducted in other group of students from pre-school to college education to understand the way in which self-regulated learning operates in each age group and class level. As present study draw sample from a limited population the results can be only hypothetically and limitedly generalised.

For path analysis a minimum – moderate number of samples were included. It is recommended that the interconnecting pathway established in this sample must be re estimated and established in a larger sample.

This research also observes the urgent need and importance for developing an IQ test for Malayalam speaking individuals and the more computerised it is the more efficient and practically applicable it would be. Practical limitation of test standardisation and measuring some factual knowledge as a measure of academic success is also emphasised.

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Appendices

APPENDIX A

INFORMED CONSENT FORM

Before your ward take part in this study it is important for you to understand why the research is being done and what it will involve. Please take time to read the information below. The researcher can be contacted if you have any doubts.

This is a study to understand what are the self-regulated learning strategies your ward uses for learning academic tasks and what role it plays in relationship between intelligence and academic achievement. For that purpose, an IQ test will be administered which can take 1-2 hours, to fill up a form of self-regulated learning and providing some personal details. Some of the academic details especially the scores of next half yearly exam would be collected from respective class teacher. Taking part in this study is not compulsory and will not affect any of the academic works. If your ward feels uneasy, he / she can withdraw at any time. Efforts will be taken for maintaining the confidentially of responses and identity of the participant.

I .....(father/ mother/ guardian) of ..... confirm that I have read and understood the research and what information will be collected. I understand that participation is voluntary and I declare the willingness to allow my ward to participate.

Signature :

Name of parent :

Name of ward :

Date :

Researcher: Miss Shamla. V.M, Department of Psychology, University of Calicut.

APPENDIX B

PERSONAL DATA SHEET

Name of the student :

Name of school :

Age :

D.O.B :

Sex :

Order of birth :

Class currently attending : Division:

Fathers name :

Fathers Profession :

Mothers name :

Mothers profession :

Place of residence :

Contact number :

APPENDIX C

SELF REGULATED LEARNING STRATEGY (SRLS)
PILOT TEST
DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF CALICUT

Prof (Dr.) C. Jayan
Professor (Rtd)
Department of Psychology
University of Calicut

Mrs. Shamla V.M
Research Scholar
Department of Psychology
University of Calicut

Name of Student:

Name of School :

Instructions:

Below are some statements related to your academic learning. Please read each statement carefully and rate how frequently you feel or act in the way described. Select your answer from the given scale and put a tick mark ✓ in the respective column provided. Below you can see an example. There are no right or wrong answer. Please answer each question as honestly as you can.

	Sample Item	Never	Seldom	Sometimes	Often	Always
1.	I am good at my school works.				✓	
	(a) …*Maths*……..		✓			
	(b) …*Hindi*…….					✓

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
1.	I try to relate lessons in one subject to other subject whenever possible.		1	1	1	1	1
	(a)	.....					
	(b)	.....					
2.	I try to relate new lessons to what I have already learned and know.		2	2	2	2	2
	(a)	.....					
	(b)	.....					
3.	I review class notes/textbooks after class.		3	3	3	3	3
	(a)	.....					
	(b)	.....					
4.	I compare my answers/class notes with other's notes.		4	4	4	4	4
	(a)	.....					
	(b)	.....					
5.	I teach lessons to my friends.		5	5	5	5	5
	(a)	.....					
	(b)	.....					
6.	When I study I practice saying lesson parts/questions and answers to myself.		6	6	6	6	6
	(a)	.....					
	(b)	.....					
7.	When I study I go through lessons and class notes and tries to find most important ideas.		7	7	7	7	7
	(a)	.....					
	(b)	.....					
8.	I memorize keywords to remind some important lessons parts.		8	8	8	8	8
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
9.	I underline or highlight important points in lessons.		9	9	9	9	9
	(a)	.....					
	(a)	.....					
10.	I usually read text books.		10	10	10	10	10
	(a)	.....					
	(b)	.....					
11.	I am confident that I can score good marks/grades.		11	11	11	11	11
	(a)	.....					
	(b)	.....					
12.	I am interested in studying.		12	12	12	12	12
	(a)	.....					
	(b)	.....					
13.	I want to get highest grade/mark in the class so I learn.		13	13	13	13	13
	(a)	.....					
	(b)	.....					
14.	I believe I can understand most difficult lesson parts		14	14	14	14	14
	(a)	.....					
	(b)	.....					
15.	I study hard to get good scores/grades.		15	15	15	15	15
	(a)	.....					
	(b)	.....					
16.	I believe learning is important for my future.		16	16	16	16	16
	(a)	.....					
	(b)	.....					
17.	I can do well in assignments/projects.		17	17	17	17	17
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
18.	I study hard to score higher than some particular friends.		18	18	18	18	18
	(a)	.....					
	(b)	.....					
19.	Whichever subject I learn I try to understand it deeply.		19	19	19	19	19
	(a)	.....					
	(b)	.....					
20.	I learn from mistakes I makes in my school work.		20	20	20	20	20
	(a)	.....					
	(b)	.....					
21.	I study hard to satisfy my teachers concern.		21	21	21	21	21
	(a)	.....					
	(b)	.....					
22.	I study hard to satisfy my family.		22	22	22	22	22
	(a)	.....					
	(b)	.....					
23.	I can solve a problem if I keep working on it.		23	23	23	23	23
	(a)	.....					
	(b)	.....					
24.	I am good at my school works.		24	24	24	24	24
	(a)	.....					
	(b)	.....					
25.	I believe learning will help for my personal growth.		25	25	25	25	25
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
26.	What I learn in this class is important for me.		26	26	26	26	26
	(a)	.....					
	(b)	.....					
27.	I believe what I learn in this class will be useful for my higher studies.		27	27	27	27	27
	(a)	.....					
	(b)	.....					
28.	Before I study new chapter thoroughly, I often skim pages to see the contents.		28	28	28	28	28
	(a)	.....					
	(b)	.....					
29.	I try to think and decide on which chapter I should learn rather than just reading any chapter.		29	29	29	29	29
	(a)	.....					
	(b)	.....					
30.	I often ask questions to myself in order to make sure I understand it.		30	30	30	30	30
	(a)	.....					
	(b)	.....					
31.	When I read if I get confused I usually refer to it.		31	31	31	31	31
	(a)	.....					
	(b)	.....					
32.	I ask myself questions in order to check whether I understood what I have learned.		32	32	32	32	32
	(a)	.....					
	(b)	.....					
33.	I allow my mind to wander during class or learning.		33	33	33	33	33
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
34.	If reading a lesson become difficult I change the way I learn (eg:- reading slowly, writing etc)		34	34	34	34	34
	(a)	.....					
	(b)	.....					
35.	I loose marks or grads because of misunderstanding.		35	35	35	35	35
	(a)	.....					
	(b)	.....					
36.	I slow down reading when lessons become difficult.		36	36	36	36	36
	(a)	.....					
	(b)	.....					
37.	I often pause myself while reading in order to check whether I understand it or not.		37	37	37	37	37
	(a)	.....					
	(b)	.....					
38.	I usually checks whether I understood what teacher took in class.		38	38	38	38	38
	(a)	.....					
	(b)	.....					
39.	I perform poorly on exams because of poor time planning.		39	39	39	39	39
	(a)	.....					
	(b)	.....					
40.	During exams I skip difficult questions and then return to it after writing easy questions.		40	40	40	40	40
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
41.	I have a specific place at home for learning.		41	41	41	41	41
	(a)	.....					
	(b)	.....					
42.	I often seek quite places for studying and if I can't find one I make sure I don't get distracted.		42	42	42	42	42
	(a)	.....					
	(b)	.....					
43.	I often record how much time I spend for studying.		43	43	43	43	43
	(a)	.....					
	(b)	.....					
44.	I ask my teacher to clarity any lessons I don't understand well.		44	44	44	44	44
	(a)	.....					
	(b)	.....					
45.	When I can't understand lessons. I seek help from another student.		45	45	45	45	45
	(a)	.....					
	(b)	.....					
46.	I usually get time to review all lessons before final exam.		46	46	46	46	46
	(a)	.....					
	(b)	.....					
47.	I often set specific time to study and carries through with it.		47	47	47	47	47
	(a)	.....					
	(b)	.....					
48.	I make sure that I keep up my learning with class teacher's lectures every week.		48	48	48	48	48
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
49.	Even if some lessons are boring I keep learning until I finish.		49	49	49	49	49
	(a)	.....					
	(b)	.....					
50.	I often procrastinates/put off studying.		50	50	50	50	50
	(a)	.....					
	(b)	.....					
51.	In order to learn difficult lesson parts (essay questions and answers) I writes summary.		51	51	51	51	51
	(a)	.....					
	(b)	.....					
52.	I makes my own questions and try to find out answers to them.		52	52	52	52	52
	(a)	.....					
	(b)	.....					
53.	I set aside more time to learn difficult lesson.		53	53	53	53	53
	(a)	.....					
	(b)	.....					
54.	I panic during exams and cannot completely answer all questions.		54	54	54	54	54
	(a)	.....					
	(b)	.....					
55.	Due to anxiety I can't concentrate while studying on the eve of exam.		55	55	55	55	55
	(a)	.....					
	(b)	.....					
56.	I won't get discouraged if I get low grade and will try hard to score more in exams.		56	56	56	56	56
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
57.	In-order to reduce my anxiety during exams, I think hoe relaxed I will be when these exams are over.		57	57	57	57	57
	(a)	.....					
	(b)	.....					
58.	If I feel anxious in taking exam, I tell myself 'you can do it'.		58	58	58	58	58
	(a)	.....					
	(b)	.....					
59.	When exam nears, in order to decrease exam anxiety I meditate.		59	59	59	59	59
	(a)	.....					
	(b)	.....					
60.	When I get bored during study time, I think about the importance of learning.		60	60	60	60	60
	(a)	.....					
	(b)	.....					
61.	When I go backward in learning activities I remember about my focus.		61	61	61	61	61
	(a)	.....					
	(b)	.....					
62.	When bored I change my study place.		62	62	62	62	62
	(a)	.....					
	(b)	.....					
63.	If I fail, I lose interest in learning.		63	63	63	63	63
	(a)	.....					
	(b)	.....					
64.	Based on lesson parts I make simple charts, diagrams or tables to help me organize my thoughts.		64	64	64	64	64
	(a)	.....					
	(b)	.....					

Sl. No.	Statement		Never	Seldom	Sometimes	Often	Always
65.	I review notes before next class.		65	65	65	65	65
	(a)	.....					
	(b)	.....					
66.	I create my own examples to make lessons more meaningful.		66	66	66	66	66
	(a)	.....					
	(b)	.....					
67	If I don't understand a sentence, I try to understand its meaning from surrounding sentence.		67	67	67	67	67
	(a)	.....					
	(b)	.....					
68.	When I study, I collect more information from other sources (library/internet etc).		68	68	68	68	68
	(a)	.....					
	(b)	.....					

APPENDIX D

SELF REGULATED LEARNING STRATEGY (SRLS)
DRAFT

DEPARTMENT OF PSYCHOLOGY

UNIVERSITY OF CALICUT

Prof (Dr.) C. Jayan
Professor (Rtd)
Department of Psychology
University of Calicut

Mrs. Shamla V.M
Research Scholar
Department of Psychology
University of Calicut

Name of Student:

Name of School:

Class and Division:

Instructions:

Below are some statements related to your academic learning. Please read each statement carefully and rate how frequently you feel or act in the way described. Select your answer from the given scale and put a tick mark ✓ in the respective column provided. Below you can see an example. There are no right or wrong answer. Please answer each question as honestly as you can.

	Sample Item	**Never**	**Seldom**	**Sometimes**	**Often**	**Always**
1.	I am good at my school works.				✓	

Sl. No.	Statement	Never	Seldom	Sometimes	Often	Always
1.	I am confident that I can score good marks/ grades.	1	1	1	1	1
2.	I am interested in studying.	2	2	2	2	2
3.	I want to get highest grade/mark in the class so I learn.	3	3	3	3	3
4.	I believe I can understand most difficult lesson parts	4	4	4	4	4
5.	I study hard to get good scores/ grades.	5	5	5	5	5
6.	I believe learning is important for my future.	6	6	6	6	6
7.	I can do well in assignments/ projects.	7	7	7	7	7
8.	I study hard to score higher than some particular friends.	8	8	8	8	8
9.	Whichever subject I learn I try to understand it deeply.	9	9	9	9	9
10.	I learn from mistakes I makes in my school work.	10	10	10	10	10
11.	I study hard to satisfy my teachers concern.	11	11	11	11	11
12.	I study hard to satisfy my family.	12	12	12	12	12
13.	I can solve a problem if I keep working on it.	13	13	13	13	13
14.	I am good at my school works.	14	14	14	14	14
15.	I believe learning will help for my personal growth.	15	15	15	15	15
16.	What I learn in this class is important for me.	16	16	16	16	16
17.	I believe what I learn in this class will be useful for my higher studies.	17	17	17	17	17
18.	Before I study new chapter thoroughly, I often skim pages to see the contents.	18	18	18	18	18
19.	I try to think and decide on which chapter I should learn rather than just reading any chapter.	19	19	19	19	19
20.	I often ask questions to myself in order to make sure I understand it.	20	20	20	20	20

Sl. No.	Statement	Never	Seldom	Sometimes	Often	Always
21.	When I read if I get confused, I usually refer to it.	21	21	21	21	21
22.	I ask myself questions in order to check whether I understood what I have learned.	22	22	22	22	22
23.	I allow my mind to wander during class or learning.	23	23	23	23	23
24.	If reading a lesson become difficult, I change the way I learn (e.g.: - reading slowly, writing etc.)	24	24	24	24	24
25.	I loose marks or grads because of misunderstanding.	25	25	25	25	25
26.	I slow down reading when lessons become difficult.	26	26	26	26	26
27.	I often pause myself while reading in order to check whether I understand it or not.	27	27	27	27	27
28.	I usually checks whether I understood what teacher took in class.	28	28	28	28	28
29.	I perform poorly on exams because of poor time planning.	29	29	29	29	29
30.	During exams I skip difficult questions and then return to it after writing easy questions.	30	30	30	30	30
31.	I have a specific place at home for learning.	31	31	31	31	31
32.	I often seek quite places for studying and if I can't find one I make sure I don't get distracted.	32	32	32	32	32
33.	I often record how much time I spend for studying.	33	33	33	33	33
34.	I ask my teacher to clarity any lessons I don't understand well.	34	34	34	34	34
35.	When I can't understand lessons. I seek help from another student.	35	35	35	35	35
36.	I usually get time to review all lessons before final exam.	36	36	36	36	36

Sl. No.	Statement	Never	Seldom	Sometimes	Often	Always
37.	I often set specific time to study and carries through with it.	37	37	37	37	37
38.	I make sure that I keep up my learning with class teacher's lectures every week.	38	38	38	38	38
39.	Even if some lessons are boring, I keep learning until I finish.	39	39	39	39	39
40.	I often procrastinates/put off studying.	40	40	40	40	40
41.	In order to learn difficult lesson parts (essay questions and answers) I write summary.	41	41	41	41	41
42.	I make my own questions and try to find out answers to them.	42	42	42	42	42
43.	I set aside more time to learn difficult lesson.	43	43	43	43	43
44.	I panic during exams and cannot completely answer all questions.	44	44	44	44	44
45.	Due to anxiety I can't concentrate while studying on the eve of exam.	45	45	45	45	45
46.	I won't get discouraged if I get low grade and will try hard to score more in exams.	46	46	46	46	46
47.	In-order to reduce my anxiety during exams, I think hoe relaxed I will be when these exams are over.	47	47	47	47	47
48.	If I feel anxious in taking exam, I tell myself 'you can do it'.	48	48	48	48	48
49.	When exam nears, in order to decrease exam anxiety, I meditate.	49	49	49	49	49
50.	When I get bored during study time, I think about the importance of learning.	50	50	50	50	50
51.	When I go backward in learning activities I remember about my focus.	51	51	51	51	51
52.	When bored I change my study place.	52	52	52	52	52
53.	If I fail, I lose interest in learning.	53	53	53	53	53

Sl. No.	Statement	Never	Seldom	Sometimes	Often	Always
54.	Based on lesson parts I make simple charts, diagrams or tables to help me organize my thoughts.	54	54	54	54	54
55.	I review notes before next class.	55	55	55	55	55
56.	I create my own examples to make lessons more meaningful.	56	56	56	56	56
57	If I don't understand a sentence, I try to understand its meaning from surrounding sentence.	57	57	57	57	57
58.	When I study, I collect more information from other sources (library/internet etc.).	58	58	58	58	58
59	I try to relate lessons in one subject to another subject whenever possible.	59	59	59	59	59
60	I try to relate new lessons to what I have already learned and know.	60	60	60	60	60
61	I review class notes/textbooks after class.	61	61	61	61	61
62	I compare my answers/class notes with other's notes.	62	62	62	62	62
63	I teach lessons to my friends.	63	63	63	63	63
64	When I study, I practice saying lesson parts/questions and answers to myself.	64	64	64	64	64
65	When I study, I go through lessons and class notes and tries to find most important ideas.	65	65	65	65	65
66	I memorize keywords to remind some important lessons parts.	66	66	66	66	66
67	I underline or highlight important points in lessons.	67	67	67	67	67
68	I usually read text books.	68	68	68	68	68

APPENDIX E

SELF REGULATED LEARNING STRATEGY (SRLS)
DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF CALICUT

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Name of Student:

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Instructions:

Below are some statements related to your academic learning. Please read each statement carefully and rate how frequently you feel or act in the way described. Select your answer from the given scale and put a tick mark in the respective column provided. Below you can see an example. There are no right or wrong answer. Please answer each question as honestly as you can.

	Sample Item	**Never**	**Seldom**	**Sometimes**	**Often**	**Always**
1.	I am good at my school works.				✓	

Sl. No.	Statement	Never	Seldom	Sometimes	Often	Always
1.	I am confident that I can score good marks/grades.					
2.	I am interested in studying.					
3.	I study hard to get good scores/grades.					
4.	I can do well in assignments/projects.					
5.	Whichever subject I learn I try to understand it deeply.					
6.	I learn from mistakes I makes in my school work.					
7.	I can solve a problem if I keep working on it.					
8.	I am good at my school works.					
9.	I believe learning will help for my personal growth.					
10.	What I learn in this class is important for me.					
11.	I try to think and decide on which chapter I should learn rather than just reading any chapter.					
12.	I often ask questions to myself in order to make sure I understand it.					
13.	When I read if I get confused, I usually refer to it.					
14.	If reading a lesson become difficult, I change the way I learn (e.g.: - reading slowly, writing etc.)					
15.	I slow down reading when lessons become difficult.					

Sl. No.	Statement	Never	Seldom	Sometimes	Often	Always
16.	I often pause myself while reading in order to check whether I understand it or not.					
17.	I usually checks whether I understood what teacher took in class.					
18.	I often seek quite places for studying and if I can't find one I make sure I don't get distracted.					
19.	I often record how much time I spend for studying.					
20.	I ask my teacher to clarity any lessons I don't understand well.					
21.	When I can't understand lessons. I seek help from another student.					
22.	I usually get time to review all lessons before final exam.					
23.	I often set specific time to study and carries through with it.					
24.	I make sure that I keep up my learning with class teacher's lectures every week.					
25.	Even if some lessons are boring, I keep learning until I finish.					
26.	I make my own questions and try to find out answers to them.					
27.	I won't get discouraged if I get low grade and will try hard to score more in exams.					
28.	If I feel anxious in taking exam, I tell myself 'you can do it'.					

Sl. No.	Statement	Never	Seldom	Sometimes	Often	Always
29.	When I get bored during study time, I think about the importance of learning.					
30.	When I go backward in learning activities I remember about my focus.					
31.	When bored I change my study place.					
32.	Based on lesson parts I make simple charts, diagrams or tables to help me organize my thoughts.					
33.	I review notes before next class.					
34.	I create my own examples to make lessons more meaningful.					
35.	If I don't understand a sentence, I try to understand its meaning from surrounding sentence.					
36.	When I study, I collect more information from other sources (library/internet etc.).					
37.	I try to relate new lessons to what I have already learned and know.					
38.	I review class notes/textbooks after class.					
39.	When I study, I practice saying lesson parts/questions and answers to myself.					
40.	I memorize keywords to remind some important lessons parts.					
41.	I underline or highlight important points in lessons.					
42.	I usually read text books.					

APPENDIX F

ACADEMIC SCORE SHEET

Name of the student :

Name of the school :

Sex :

Class and division :

Enrolment number :

Subject	First Language	Second Language	English	Hindi	Social Science	Physics	Chemistry	Biology	Maths
Max. Mark	50	50	100	50	100	50	50	50	100
Mark Obtained									

Total Mark obtained:

APPENDIX G

ACADEMIC MOTIVATION SCALE (AMS-HS 28)

HIGH SCHOOL VERSION

WHY DO YOU GO TO SCHOOL ?

Using the scale below, indicate to what extent each of the following items presently corresponds to one of the reasons why you go to school.

Does not correspond at all		Corresponds a little		Corresponds moderately		Corresponds a lot		Corresponds exactly
1	2		3	4	5		6	7

WHY DO YOU GO TO SCHOOL ?

1. Because I need at least a high-school degree in order to find a high-paying job later on.	1	2	3	4	5	6	7
2. Because I experience pleasure and satisfaction while learning new things.	1	2	3	4	5	6	7
3. Because I think that a high-school education will help me better prepare for the career I have chosen.	1	2	3	4	5	6	7
4. Because I really like going to school.	1	2	3	4	5	6	7
5. Honestly, I don't know; I really feel that I am wasting my time in school.	1	2	3	4	5	6	7
6. For the pleasure I experience while surpassing myself in my studies.	1	2	3	4	5	6	7
7. To prove to myself that I am capable of completing my high-school degree.	1	2	3	4	5	6	7
8. In order to obtain a more prestigious job later on.	1	2	3	4	5	6	7
9. For the pleasure I experience when I discover new things never seen before.	1	2	3	4	5	6	7
10. Because eventually it will enable me to enter the job market in a field that I like.	1	2	3	4	5	6	7
11. Because for me, school is fun.	1	2	3	4	5	6	7
12. I once had good reasons for going to school; however, now I wonder whether I should continue.	1	2	3	4	5	6	7
13. For the pleasure that I experience while I am surpassing myself in one of my personal accomplishments.	1	2	3	4	5	6	7

14. Because of the fact that when I succeed in school I feel important.	1	2	3	4	5	6	7
15. Because I want to have "the good life" later on.	1	2	3	4	5	6	7
16. For the pleasure that I experience in broadening my knowledge about subjects which appeal to me.	1	2	3	4	5	6	7
17. Because this will help me make a better choice regarding my career orientation.	1	2	3	4	5	6	7
18. For the pleasure that I experience when I am taken by discussions with interesting teachers.	1	2	3	4	5	6	7
19. I can't see why I go to school and frankly, I couldn't care less.	1	2	3	4	5	6	7
20. For the satisfaction I feel when I am in the process of accomplishing difficult academic activities.	1	2	3	4	5	6	7
21. To show myself that I am an intelligent person.	1	2	3	4	5	6	7
22. In order to have a better salary later on.	1	2	3	4	5	6	7
23. Because my studies allow me to continue to learn about many things that interest me.	1	2	3	4	5	6	7
24. Because I believe that my high school education will improve my competence as a worker.	1	2	3	4	5	6	7
25. For the "high" feeling that I experience while reading about various interesting subjects.	1	2	3	4	5	6	7
26. I don't know; I can't understand what I am doing in school.	1	2	3	4	5	6	7
27. Because high school allows me to experience a personal satisfaction in my quest for excellence in my studies.	1	2	3	4	5	6	7
28. Because I want to show myself that I can succeed in my studies.	1	2	3	4	5	6	7

APPENDIX H

ANALYSIS OF THEORIES OF INTELLIGENCE: EMERGING THEMES

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Abstract: Intelligence has profound implications on our life. Even though historical theories have originated in the past they have continued influence on our contemporary world. Each theorist describes and defines human intelligence in different ways. After hundred and twenty years there is no concise definition for intelligence. As theoretical and empirical research on intelligence advances, views about nature of intelligence continue to evolve with them. Even though there is no a single definition, by proper inspection we can see quite similarities between some. And some actually say same thing in different ways. We are trying to analyse different definitions of intelligence proposed so far in literature. Our aim is to sketch briefly, what theorises so far proposed, explain on what intelligence is and does, and how. Qualitative thematic analysis of published articles, books etc. of 14 intelligence theorists were analysed to form 11 emerging themes. Each theme was then discussed in detail.

IndexTerms **- Intelligence , Qualitative thematic analysis, Emerging themes.**

I. INTRODUCTION

Human is the most intelligent being on earth, maybe in the entire solar system. Everyone agrees on this fact, but no one agrees on meaning, nature, and measurement of intelligence. Those who start reading about intelligence will get confused in front of hundreds of theories. More one read about it the more one starts thinking it as immeasurable and measuring immeasurable is making a chaos. But conceptualizing intelligence as immeasurable and denying the concept altogether will be the most idiotic choice we make. We have to search a new way to study intelligence.

What is intelligence? It turns out that the answer depends on whom you ask, and that the answer differs widely across disciplines, time, and places (Sternberg & Kaufman, 2011).Research on intelligence started in 1880's, now its 21st century and still, there is no a standard definition of intelligence. So some started believing intelligence can be described but cannot be fully defined. Analysing every theory defined in the history of 'Intelligence' is an impossible task. Definitions presented here include those which are frequently referenced and cited. By opening the black box of intelligence and through thorough analysis we are trying to work out a way through puzzles of conflicting ideas and theories to enhance knowledge about intelligence.

1.2 AIM

The main research aim was to understand the nature of intelligence. In this study main research questions posed were

- What is intelligence?
- What do theorists so far explain about intelligence?
- Can we derive a concise view of intelligence?

II. METHOD

The qualitative thematic analysis involved processes of condensing each theorist's definition and the concept of intelligence into categories or themes based on valid inference and interpretation. Based on some inclusion criteria certain search terms were defined.14 theorists and their originals works were selected. The qualitative thematic analysis was done and 9 emerging themes were tabulated. Analysis and interpretation of each theme are discussed in detail.

III. RESULT AND DISCUSSION

While analyzing a plethora of intelligence theories to find an answer to the question, 'what is intelligence'- the first idea struck researcher was about the ambiguity of term itself. Most of the articles on intelligence have at least one statement regarding ambiguity, (Hunt & Susanne, 2013; Sternberg 1985; Vernon 1979).This was predicted by Spearman a few centuries ago, *"In truth, intelligence has become a mere vocal sound, a word with so many meanings that finally it has none"* (Spearman, 1927). It is not surprising, as Vernon pointed out; ambiguity is

due to using of intelligence in a different meaning in daily life (Vernon, 1979).

A foundation for the study of human intelligence was laid in late 19th century. Galton suggested the presence of general ability or natural ability. He limited his focus on to experimental study of perceptual and sensory functions (Thurston, 1946), how this functions cause individual difference, individual difference in intellectual power and Eugenics (Burt,1969).The problem of intelligence was then researched by Binet by his studies on school children. His hypothesis was - student's mental power determines how they progress in school. Based on this hypothesis, Binet developed test to identify scholastically backward children. He proposed the term 'intelligence'- an old scholastic word which was used by Spencer (Burt 1969). As we can't discuss in detail all emerging themes in detail we have tried our best to convey what we intended.

3.1 Term for intelligence as whole

It seems mental ability is the most preferred term when we talk about cognitive functions alone and if we broaden the concept to include all life activities it's better to use the term intelligence. Spearman (1927) used the term 'general intelligence' and 'mental ability' or code letter 'g'. Thurston (1938), Jensen (1969) argued for use of the term 'primary mental abilities' or 'mental abilities'. Gardner (1983) sticks to plural term 'intelligences'. Vernon and Eysenck followed Hebb (1949) and named it as intelligence A, B, C (Vernon,1979). Wechsler (1944) and Cattell & Horn (1972) preferred to use 'capacity' instead of 'ability' and specifically named it as 'general intellectual capacity' and 'cognitive capacity' respectively. Others like Piaget, Boring, Guilford, Das wasn't interested in this term controversy, so followed Alfred Binet and merely used the term 'intelligence'. As years passed research in this area grew, different varieties of tests developed, statistics were improved, empirical studies increased, in some areas conceptual innovation occurred. But the term 'intelligence' prevailed and became publically popular despite all controversies.

3.2 Intelligence as a construct

Here we define construct as a variable which summarizes theoretical observations of each theorist's notion of intelligence into definition and structure. Various intelligence theories to be considered define 'intelligence as a construct' -differently. We classify it as 8 classes: stimulus-response, functions, adaptation, potential, functions/ability, 'g', ability.

3.2.1 Intelligence as stimulus-response connection:

Thorndike was a 'learning' theorist so, viewed intelligence as a stimulus-response connection – and reject possibility of unique mental ability. He proposes three kinds of intelligence; Verbal intelligence, social intelligence, practical intelligence(Wechsler,1944).Thorndike's Practical intelligence-facility in manipulating objects is comparable to Sternberg's(1999) Practical intelligence -the ability to adapt to an environment. But without manipulating objects we can't adapt to our surrounding. Thurston focuses on the action of an individual while Sternberg focuses on the product of that action. Verbal intelligence – facility in the use of symbols can be seen as a part of Sternberg's (1999) Analytical intelligence.

3.2.2 Intelligence as a function:

Almost at the same time when Thorndike defined intelligence as stimulus-response, Spearman had started to define it as function. As a construct Spearman defines intelligence as one fundamental function that is common in all intellectual activity. It is noted that Spearman does not identify his 'g' with general intelligence in a popular sense. It is only one factor present in every operation involving intelligence. Later spearman explains 'g' as one single, universal, fundamental, function and's' as purely specific actions; specific to one ability. Later he identifies 'g' with attention and mental energy (Spearman, 1927).Later hierarchy concept of intelligence was developed based on Spearman's 'g'.

3.2.3 Intelligence as capacity:

After intelligence was 'functionally defined' it was defined as capacity by Boring (1923).Other theorist like Weschler (1944) and Vernon (1950) critics Boring for narrowing intelligence as a testing quantity. But we can see that Wechsler (1944) redefine 'intelligence' for developing his widely and continuously used test of intelligence as "ability to utilize 'g' or energy in contextual situations". But this substantiate Edwin .G. Boring's definition of measurable intelligence that, Intelligence as a 'measurable capacity' is defined as capacity to do well in an intelligence test (Boring,1923).

But unlike 'function', 'capacity' definitions of intelligence prevail to be used in intelligence history. Thurston state intelligence as a capacity to inhibit instinctive behavior and modify behavior by means of imagined stimulus. Most of the other theorist focus on the product of intelligence, but Thurston focus on things that are accomplished by intelligence (since intelligence is not a tangible thing) and doesn't give value to nature of intelligence (Wechsler,1944). He proposes 7 primary mental abilities some of which are comparable to Gardner's multiple intelligences. David Wechsler (1944) view intelligence in terms of capacity i.e. aggregate or global capacity to think, act and deal effectively. It includes the cognitive part (think), realistic action part, the effectiveness of the product part.

3.2.4 Intelligence as adaptation:

Piaget compared intelligence with a biological organization and sees intellectual structures as organs. Intelligence is seen as adaption through accommodation and assimilation. Sternberg's concept of practical intelligence involves adaptation to the environment. Here adaptation is the ability to change environment according to one's need for success. But Piaget's concept of adaptation involves the ability to change the schema for incorporating new schemas. One is external (Sternberg's adaptation) and other is internal (Piaget's adaptation) (Sternberg, 1999, Piaget, 1952). Intelligence as 'adaptation' wasn't popularly accepted.

3.2.5 Intelligence as potential:

Vernon (1950) accepts Hebb's (1949) definition of 'intelligence A' as the basic potentiality of the organism. Other theories also discuss intelligence A, B, C but don't explicitly state or name it as such. Spearman (1927) view 'g' as a common factor which is present in all test of mental ability and defined it as ability needed for all tasks. So spearman's 'g' can be identified with intelligence B. Horn present evidence for genetic determiners determining in which direction intelligence develops and named it fluid intelligence following Cattell (Cattel & Horn, 1972). So Fluid intelligence can be equated to intelligence A. Boring define intelligence as a measurable quantity. So his intelligence can be included in intelligence C (Boring, 1923).Gardner (1983) defines intelligence as a bio-psychological potential to processes information. Gardner maintains 7 or more independent domains/mental faculties/intelligences- in which Spatial intelligence is comparable to Thurston's spatial visualization and perceptual speed.
Intrapersonal intelligence and interpersonal intelligence are comparable to Thorndike's social intelligence. Logical-mathematical intelligence is comparable to Thurston's number facilities and reasoning. Linguistic intelligence is comparable to Thurston's word fluency, verbal comprehension.

3.2.6 Intelligence as Function/Ability:

Guilford's (1968) structure of intellect model present intelligence as a collection of both ability and function needed for processing of information. The cubical model represents 5 operations, 4 content and 6 products. All intellectual ability has a unique combination of operation, content, and product. Anastasi (1992) also viewed intelligence as a combination of abilities or composite of several functions needed for survival in a culture. She couldn't specify if the abilities or function occur as a thought processes or as an external behaviour.

3.2.7 Intelligence as 'g':

From his factor analytic studies, it was Spearman (1927) who proposed the concept of 'g'. But he defined intelligence in terms of a fundamental function and later introduced this one letter code. Wechsler (1944) agrees with Spearman and define 'g' as psycho- mathematical quantity which measures the minds capacity to do intellectual work. He regards 'g' theory of intelligence as a universally accepted concept of intelligence. Grottfredson (1998) agrees with this concept and believes in the existence of 'g' at top of the hierarchy of mental abilities. Vernon (1950) also suggest the existence of 'g' at top of hierarchy below which there are several major, minor, specific factors. But the degree of specificity of spearman's specific abilities and Vernon's specific factors can't be distinguished (Gardner & Robertson, 2004). But it was Jensen who defined it as such, "g factor of mental tests". 'g' is an open-ended category that includes all processes of cognition (Jensen, 1969 &1980).

3.2.8 Intelligence as an ability:

After 'Capacity definition' of intelligence, Intelligence defined as 'ability' became more popular. Vernon (1950), Das (2009), Grottfredson (1998), Sternberg (1999), was the prominent psychologist who defined intelligence in terms of 'ability to do something' and then that something was defined. For Grottfredson it was an

ability to deal with complex cognition but Das specified it more clearly as an ability to plan and structure behavior. Vernon also defined it in terms of behavior; intelligence B-ability showed through behavior. For Sternberg, it was simply an ability to succeed.

3.3 Independency v/s dependency

Spearman, Thurston, Guilford, Gardner, and Das, view intelligence as independent. But on what this independence occurs is different for everyone. For Spearman (1927) 'g' and's' is independent. Thurston (1938) present factors as independent vectors. Guilford's (1968) numerous factors (abilities) are relatively independent in a population but have common involvement in an intellectual activity, because all intellectual ability involves a unique combination of one kind of content, operation, and product. One of Gardner's (1998 &1992) major claims is, 7 intelligences are relatively independent. Das main focus is on independent cognitive functions which work interdependently (Naglieri, Das, 2002).

Wechsler, Jensen, Grottfredson demonstrate flexible stand of interdependency. According to Wechsler, (1944) abilities are not entirely independent but are qualitatively differentiable. Jensen (1969) states that level I and level II types of mental processes are functionally dependent but genotypically independent. In Grottfredson's (1998) view all abilities are interrelated and not independent because all these abilities have more or less correlation with g.

One of the prominent theorists who view intelligence as dependent is Sternberg. For him, all three kinds of abilities are ultimately the result of the interactions of three kinds of information-processing components: meta-components, performance components, and knowledge-acquisition components. Here interaction occurs between information processing components so abilities seen as dependent. Dependency to particular problem and situation is also emphasized (Sternberg, 2003).

3.4Culture and intelligence

Influence of culture is one of the prominent controversies that are going on in literature related to intelligence and its assessment. Anastasi, Gardner, and Sternberg strongly argue for cultural influence. As three of them define intelligence differently, 'how' and 'on what' culture will influence also varies greatly. Thus for Anastasi, it is on survival abilities, for Gardner, it's on intelligences, and Sternberg it's on effective information processing components.

Anastasi sees intelligence as a combination of abilities required for survival and advancement within a particular culture. In different historical times even in the same culture, the qualification for survival and achievement differ. So there is no need to tell about different cultures. In short, abilities vary with time and place (Anastasi, 1992).Gardner (1998) reasoned that culture determines which of the 7 intelligences in what combinations are highly valued in a given society. Sternberg's theory of Successful intelligence is defined as an ability to succeed in life within one's socio-cultural context. The componential aspect of intelligence is same for all culture. i.e Information Processing components are universal. But which information processing components are more effective, is culturally determinant and culture-specific .i.e contextual aspect of intelligence is relative. Thus culture determines which intelligence effectively facilitates environmental adaptation (Messick, 1992).

Grottfredson (1996) strongly argues against cultural influence on intelligence. She strongly disagrees the influence of culture on 'g'. She says "culture doesn't construct 'g' or cultures construct same 'g'". Guilford (1968) gives more emphasis to experience than culture. He concludes that intellectual ability of a person is generalized skill developed through experience within a certain culture.

3.5 Nature v/s nurture

Under this theme, we try to understand long-standing debate going on in psychology, particularly in intelligence research. By nature, we meant those theories which view environment determine intelligence, by nurture, we mean gene determine intelligence.

Thurston's (1946) study of identical and fraternal twins agree with previous research that inheritance plays an important part in determining mental performance. He also assures that mental abilities are trainable but the outcome performance depends on native ability. Anastasi argues intelligence is not heritable. She emphasized the role of experience, i.e. Antecedent experiences not only affect intellectual development as a whole but every category identified as an ability (Anastasi, 1972 & 1992).

Majority of theorists take a flexible position – both nature and nurture determine intelligence. Of those, Sternberg was prominent theorist who argued for interactionism view. Sternberg view intelligence is a result of

genes X environment interaction. (Sternberg, 2003).

3.6 Individual difference

By this theme, we infer how each theory discusses individual difference and the reason behind Galton's quest 'why an individual is different'. Earlier theories reason that individual difference is due to genetic variation (Jensen, 1969; Thorndike, 1925; Thurston, 1938). Later on, after the spreading of cognitive psychology, theories consider individual difference was due to the difference in cognitive processing (Das, 2009; Gardner, 1998; Guilford, 1968).

3.7 Assessment

Here we try to identify what each theorist criticise about traditional intelligence test. Traditional test measure only abstract abilities, analytical abilities or scholastic aptitude (Anastasi, 1992; Guilford, 1968; Thorndike, 1925; Spearman, 1927; Sternberg, 2003).They also propose tests which complement their proposed theory of intelligence. Thurston (1938) argue for inclusion of primary mental abilities, Wechsler (1944) for non - intellective factor, Piaget (1952) gave importance to 'why a child responded in a given way', Sternberg (2003) for the inclusion of practical and creative abilities.

3.8 Age

Theorists (Boring, 1923; Piaget 1952; Thurston, 1938; Wechsler, 1944) agree with the notion intelligence mature at adolescence. But Thurston has the opinion some abilities mature more early and Wechsler specify it by saying some abilities mature by age 12 and some by age 15.

3.9 Methodology

In methodology, we analyze what method each theorist used for their study of intelligence. It varies from experiments with animals (Thorndike, 1901), factor analysis (Spearman,1927), developmental psychology (Piaget,1952), Psychobiology (Thurston,1938; Jenson,1969), interdisciplinary approach (Moran & Gardner, 2006) cognitive psychology and psychometric analysis (Anastasi,1992; Grottfredson,1998; Sternberg,1985) to Luria's Neuro-imaging studies and clinical study of brain lesion (Das, 2002).

IV. CONCLUSION

Each and every theory contributes to our understanding of nature of intelligence. It seems intelligence can be defined either in term of ability /capacity or in term of cognitive functions or product of such functions. The analysis reveals that genetic variation and difference in cognitive processing leads to individual difference. This work also strengthens the idea that culture an important role in determining what intelligence is. Also, it substantiates the fact that interdisciplinary approach or method of converging operation is the best method for studying intelligence.

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PRESENT STATUS OF INTELLIGENCE TESTING: A CRITICAL ANALYSIS OF WAIS, WAPIS AND MISIC

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ABSTRACT

Theoretical and practical understanding of intellectual assessment is of considerable importance to clinical psychologist and other professionals working in this area. In recent years intelligence testing has attained high popularity as there has been considerable focus on empowerment of disabled children by Kerala government. This study is an independent examination of intelligence tests. The tests WAIS, WAPIS, MISIC are reviewed and analyzed. These are the most popular tests used for intellectual assessment. Discussion focuses on serious theoretical and methodological flaws. The standardization issues of outdated norms and cultural consideration of these instruments from researcher's perspective provide further insight to tests inability to truly determine an individual's intelligence. But no effort has been taken to focus discussion on consequences of using outdated intelligence test. We argue that efforts should be directed toward developing indigenous tests with detailed item analysis particular to Kerala population.

KEYWORDS: Intellectual Assessment, standardization, WAIS, WAPIS, MISIC.

Present Status of Intelligence Testing: A Critical Analysis of WAIS, WAPIS and MISIC.

Intelligence testing is a decade old concept and controversies relating to it are never meant to an end as psychologist haven't reached to a concise definition for the term 'intelligence' itself. Intelligence tests have been developed for fulfilling a need to classify individuals on the basis of individual difference. In 1938 Calcutta University pioneered the research in intelligence testing especially in selection and guidance. Thus it became one of the earliest interests of psychologist in India (Basu, 2016).During the early 20th century psychologist merely used western tests. After independence, focus on adaptation and standardization of western intelligence tests increased. There were attempts of indigenization but such tests didn't

make popularity like adapted versions of Wechsler and Binet tests of intelligence. (Basu, 1938; Shamla& Jayan,2017)

Now Intelligence assessments are widely used from children to adults to old age and from public to private organizations. Flynn has been credited with having discovered the increase in IQs that has been reported in a number of countries during most of the twentieth century and that has come to be known as "the Flynn effect" (Lynn,R; 2014). If Flynn effect is really happening then Cognitive tests adopted in 90's will be inadequate to asses' 21st century children. Also, cross cultural suitability of these tests cannot be assumed mainly because of the cultural and educational difference of past and present generation. This suitability is questionable and infrequently studied. Children of past generation will be unfamiliar with testing procedures and materials which is in sharp disparity with comparatively high level of test-wiseness of present generation. Popularization of IQ tests through one click availability of intelligence test in online (even though standardization is questionable) and advertisements for improving ones IQ, make today's child familiar with test items. For e.g.: working with figures and puzzles may be a novel experience for children of 19thcentaurywhere as today's children and adults are exposed to these tasks at preschool level due to explosion of online and mobiles games.. There are special android apps to improve memory power, eye hand coordination, reasoning ability, visuo-spatial ability and so on which are freely available in the market. Exposure such apps can act as practise effect.

Along with vast applications of intelligence tests there is common challenge in overcoming cultural differenciation. Existence of a universal psychological process across culture is a debatable and controversial issue. But in intelligence assessment, consideration of cultural norms is critical (Georgas, Weiss, van de Vijer&Saklofske, 2003; Sternberg, 2007) as there is evidence for existence of cultural influence in defining the concept of intelligence (Georgas, et.al, 2003; Mpofu, Ntinda, & Oakland, 2012 ; Sternberg & Grigorenko,2004).Even if we set aside ethnic differences in IQ testing, we can see that IQ tests have more nuanced questions which measure different thing for different individuals based on individual difference (eg:creative individual) in approaching a question. Such criticisms have been discussed by James C Kaufman (2010) in 'Using creativity to reduce ethnic bias in college admissions'.

A survey done by authors (Shamla& Jayan,2017) found out that Wechsler and Binet series and their adaptations are widely used in Kerala as a measure of intelligence and in India generally (Andrade & Jamuna,2004 ; Basu,2016).In this chapter there is a detailed criticism of oral translation of test items to another language. Authors discuss it in the light of instrument bias, gender specific references; difference in cultural practices with in same community. Oral translation of digit span test to mother tongue is discussed based on Baddeley's phonological loop model i.e. monosyllable English digits when translated become disyllabic or trisyllabic . Language acquisition differences in first language and second language acquisition is also

presented and in this chapter we argue that clinicians should stop oral translation of items while IQ testing.

In this review we try to critically analyze each test mainly from a cultural perspective. First author has been born and brought up in Kerala and administered the tests as part of graduation and post-graduation course. Here we haven't done item wise critic by administration in a large sample to know the adequacy to present population. But each test items and manual are analyzed based on its cultural adequacy, cultural obsolescence, and content relevance to present Kerala population. We could not find an extensive study on language bias in administration of intelligence especially relating to Malayalam speaking individual. We also observed that India lack a critical review, independent analysis, test review, critique and commentary on Indian standardized intelligence test. There is a wide research gap owing to be filled.

Wechsler Series Of Intelligence Tests

Wechsler adult intelligence scale and Wechsler intelligence scale for children are widely used intelligence assessment tools across the world (Esters & Ittenbach,1999; Georgas, Weiss, van de Vijer&Saklofske, 2003; Wayne, Camara, Julie, Nathan,& Antonio,2000).Wechsler's experience in army testing program by administering army intelligence tests and Binnet- Simon scales along with his professional practice lead him towards the development of Wechsler - Bellevue intelligence scale in 1939, which measured both verbal and non-verbal intelligence. He developed the test because the tests prevailed at that time was inaccurate when applied to measurement of adult intelligence as material that form part of testing was unsuitable for adults. There was also heavy reliance on verbal abilities which Wechsler thought created unfair assessment (Wechsler, 1944).

Wechsler contributed one of the most popular and accepted definition of intelligence- "*aggregate or global capacity of the individual to act purposefully, to think rationally, and deal effectively with his environment*" (Wechsler, 1944). He also state that intelligence is not sum of abilities and ultimate product is quality or configuration of abilities. In his opinion the only way to evaluate it quantitatively, is by measurement of various aspects of abilities. He also suggests that before developing a test we should explicitly state what we understand by general intelligence. Failure to do so compel others to think that intelligence is what intelligence test measure. Wechsler redefine intelligence for his widely and continuously used test of intelligence as "ability to utilize 'g' or energy in contextual situations-situations that have content, purpose, form and meaning". He admits that his test does not measure all that goes up to make general intelligence but measure portion of intelligence (Wechsler, 1944).

It was one of the criticisms of Wechsler's time that he did not create intelligence test explicitly from theory (Flanagan & Harrisons, 2012). But Wechsler claims that his test measure portion of intelligence which enable us to use it as a fairly reliable index of individual's global

capacity (Wechsler, 1944) and selection of tests is not based on explicit theory of intelligence but on cognitive aspects of intelligence that is important to assess(Georgas, Weiss, van de Vijer&Saklofske, 2003).But this substantiate Edwin .G. Boring's definition of measurable intelligence that Intelligence as a measurable capacity is defined as capacity to do well in an intelligence test (Boring,1923). Eventhough Wechsler had explicitly stated in his book "*Measurement of adult intelligence*" that hypothesize assumed in construction of his scale is ability to utilize 'g' and tests does not measure all of these abilities, we could see references by test developers and others pointing Wechsler tests of intelligences measure intelligence represented by Wechsler 's definition of intelligence (Canivez& Watkins,2016; Pearson Education,2008).

While explaining selection and description of test he confronts lot of difficulties that one has to face while one attempt to devise an intelligence test. He also obviously state that one single person can't do such a research project alone (Wechsler,1955). He has done a brilliant job in combining and integrating various intelligence tests of the time that had already been more or less developed and clinically administered. We don't expect such a great statistician and scholar in intelligence like Wechsler did not devise an original or brand new intelligence test. That wasn't his aim at all. He selected from, whatever sources available, a combination of tests that would best meet requirement of an affective adult scale. This tradition of Wechsler series of intelligence test is widely mocked by Sternberg (1993) in 'Rocky Back again, A review of WISC –III'. We can see that Information subtest can be found in army alpha test, General comprehension test is of Binet-Simon scale & army alpha Memory span was part of original Binet scales, Picture arrangement test is from army alpha and new york magazine, Healy picture completion test along with mutilated picture of Binet -Simon scale is used, Block design originally from koh's block and Object assembly is from Pinter Peterson scale (Wechsler, 1944). But combination of strong statistical procedure and clinical skills applied in devising the test lead to its popularity today. Prolific research articles and literature on Wechsler intelligence tests is also an indication of great interest these tests had generated in case of utility.

WAIS-wechsler adult intelligence scale.

It was a great turning point in intelligence testing when first major revision of Wechsler Bellevue was published in 1955 as Wechsler adult intelligence scale-WAIS. Further revisions resulted in publication of WAIS-R, WAIS-III WAIS –IV. Later revisions of Wechsler series enhance the measure of intelligence by dropping verbal and practical intelligence dimensions (the dual IQ structure) and added precise domain of cognitive functioning- Verbal comprehension scale (similarities, vocabulary, information), Perceptual reasoning (Block design, matrix, visual puzzle), Working memory (digit span, arithmetic),processing speed(symbol search and coding).Other supplementary tests were also added. In the latest revision of WAIS, test materials, item content, administration procedure were updated and new

subtests were included (Pearson education,2008).Index scores aligns with advances in neuropsychology, cognitive psychology and diagnosing other disabilities like learning disability and ADHD. Each new revision slowly introduces elements similar to contemporary advance in theory. Thus if WAIS was explained theoretically by spearman's g WAIS IV can be better explained by CHC theory (Benson,Hulac& Kranzler,2010). Research also confirm overload of crystallized intelligence in subtest measures of WAIS-IV (Aken, Kessels, Wingbermühle, ,Wiltink, Heijden&Egger,2014). We could also critically question does these changes decrease the test's quality in measuring intelligence as represented by Wechsler.

This new evolutionary change can be seen as positive help for a clinician. But advantages of revised test would only reach a community if only professional's start administering it, If professional's have to administer them, they have to be trained in new versions. Academically such revisions can't be seen.(source: M. PHIL. CLINICAL PSYCHOLOGY :Guidelines & Syllabus ;Effective from Academic Session 2017-18 ,RCI –New Delhi).

Wechsler decides the prime age of intelligence is between 20-34 and use scores obtained at this age group as reference for preparing scaled scores. Wechsler does not provide any scientific support or explanation for deciding upon above age group. We have to question the suitability of keeping above age group as a representative sample for preparing scaled scores for new generation.

There is no need in spending time thinking of validity of item of WAIS, as the original English version has reached IVth edition now. But some issues have to be pointed out as our survey (Shamla& Jayan,2017) has shown professional's using the same.

In information subtest most items are not valid to Kerala population. Mere translation will not capture what the subtest meant to measure, especially with items which ask for name authors of fictional literatures, distance between places, name of presidents, etc. Wechsler described,

"In practice, the value of an information test will depend in a large measure on the actual items which are included in it. There are no universal principles which can serve as unfailing guides to "good" questions. In general, the items should call for the sort of knowledge that an average individual with average opportunity may be able to acquire for himself".

For such a test to be developed a through item construction and item analysis have to be done based on knowledge available to an average individual. In picture arrangement, outlined pictures represent old European styles .The picture completion test also include pictures that an average adult of Kerala can't identify. The form and content is too culturally biased. Most items are too risky for oral translations. Flaws in local translation of items and vernacular translation of digit span are explained in general based on, difference in development and acquisition of each

language and difference in memorization for different number of syllables. (Shamla& Jayan,2017).

Most of the intelligence test, including Wechsler provides a group of possible correct responses for similarities, picture arrangement and comprehension subtest with varying degree of scores. If the testee provides alternative responses, then they are considered wrong and not accepted. One who devises the test decides what the correct response is (on the inspection of correct answer by a sample of people, low scores are provided for imperfect arrangements proportional to number of similar response obtained). Wechsler (1955) explains

"The pictures are presented to the subject in a disarranged order and he is asked to put them together in the right order so that they make a sensible story. The correct order is the one originally given to the pictures by the artist."

But the concept of intelligence behind the subtest picture arrangement is

"subject's ability to comprehend and size up a total situation. The subject must understand the whole, must get the "idea" of the story before he is able to set himself effectively to the task".

If such ability, which others call as social intelligence (Wechsler, 1955) is assessed then the pictures here provided (especially higher order series of pictures) can have so many different stories. How can we decide correct response based on "common thinking" and provide low score or no score to those who think out of the box? Then we will have to consider intelligence as a concept which does not include originality, novelty and creative thought. Wechsler (1955) says rejecting the subject's response does not significantly influence his total score on the test. Then what is the point of keeping such subtests for obtaining full-scale IQ.

Above critical thoughts are also applicable to comprehension subtest were subjective responses are possible. There is no exaggeration if one responds to item about 'fell down letter' as "I won't pick it up, it may contain illegal items or even small bomb". Social situations have changed now were we see such news in newspapers and if one respond as above there is no wrong in doing so. We could see that in WAIS –IV picture arrangement and comprehension subtest scores are not included in calculating Full-scale IQ.

To this point, we have discussed critically about WAIS and need of professional's to be updated in administering new versions. Similarities subtest also have above problem of finding correct response. For this issue we may discuss a research article. Irving E. Sigel, 1963 in her article *"how intelligence tests limit understanding of intelligence"* explain briefly about the need for assessing underlying processes. She also questions the logic of taking *"the conventional class logic as the preferred response"* as we are obvious about cultural and social differences. In her view while assessing intelligence we have to assess cognitive styles in thinking too .i.e. Along

with "what", we have to look for "how" did respondents respond. One of her study of sorting and labeling figures found out humans while doing such task employ labels which can be classified as descriptive, relational-contextual and categorical-inferential labels (Sigel, 1961).She further discuss how studying such labels help us to understand intellectual function. She also questions the restriction in not providing adequate assessment of an individual's repertoire of responses. For eg: If a person respond a cat and a mouse are alike because 'they have tails', does not mean, however, that he is unable to provide a more "abstract" answer if required to do so. Sigel criticize that there is no provision for such an opportunity. She discusses the possibility of providing for alternative responses, alternative scoring, or analytic procedures (Sigel, 1963).

Wechsler Scales in India

According to global developmental changes and changes in academic tutoring lot of items have been revised or replaced in WAIS IV Indian edition, but these positive changes could be effective in Kerala if only the tests is revised and standardized according to Kerala culture. JayantiBasu (2016) observes that this is the problem specific to India, were cultural variations must be exclusively studied by differences in spoken language in India, as there are 22 official languages and 781 spoken languages which are well developed and have a rich literary tradition of their own. Therefore, the term Indian adaptation connotes adaptation for a specific target community only. This complicates the entire process of adaptation and development of assessment tools in India. King of intelligence testing- Wechsler (1955) argues, standardization should represent as closely as possible with population for which tests is intended.

WAPIS- Wechsler Adult Performance Intelligence Scale.

In India, PrabhaRamalingaswamy (1974) was first person to focus on adaptation and standardization of WAIS – performance subtest and published it as WAPIS-Form PR. Standardization of verbal part of the WAIS was done by Pershad and Verma (1988) as The Verbal Adult Intelligence Scale (VAIS).Later on adaptation and standardization of Wechsler intelligence tests were done by billion dollar business agencies were a representative sample from Kerala is not included. Clinicians of Kerala administer old and outdated WAPIS (Shamla& Jayan,2017) in which most of the items are three decades old.

In Wechsler Adult Performance Intelligence Scale - Digit symbol, block design, and object assembly remained the same. However, cultural modifications were done in picture completion and picture arrangement subtests. The test was standardized on a sample of 604 individuals between 15 and 45 years. (Ramalingaswamy, 1974).WAPIS is standardized for 45 years because during adaptation of WAPIS average life expectancy was 42 years. Due to rapid progress in medical science, author hope that norms will be extended in future, as there will be increase in life expectancy. But such extension cannot be seen. Today a clinician will have to

administer WAPIS well above that age group, as life expectancy increased to 67.9 years in India and it is about 74.9 years in Kerala. (UNDP-INDIA, 2013).

Norms are developed according to 1961 census representations of gender, Socio economic status education and samples were collected from in and near about Delhi.15th Indian census of 2011 shows that population increased to 121 core, adult literacy rate increased to 17.64% and the sex ratio in 1961 was 941 females per 1000 males which became 943 females per 1000 males in 2011(www.census2011.co.in.). In essence WAPIS norms will not represent 21st century national sample stratification by sex, education, and religion. In original version they have taken sample from Delhi only. We could see samples include Malayalam speaking individuals too, but how could a 1970's Delhi Malayali represent 2017 Keralite?.

In picture arrangement subtest Wechsler selected pictures from American scene and he himself has seen subjects of foreign origin get puzzled and sometimes some pictures favors subject's from a particular cultural origin. In WAPIS some stories cannot be easily recognizable in Kerala culture,foreg: a rich man flirting a woman passing by, and a man with women statue travelling in taxi to show he is in relationship, rich man or king fishing by utilizing his servant.Most characters in picture arrangement wear old north Indian style of dressing. Same is especially true for policeman, rich man /king and cars, thatched house. Picture completion includes some items which 21st century adult Keralite may not be familiar. These subtests have items whose form and content are questionable while applying to 21st century Kerala culture. Also the clarity of printing must be questioned. Material and sketches on object assembly must be improved.

MISIC-Malin's Intelligence Scale For Indian Children

Malin's intelligence scale for Indian children (MISIC) is widely used in Kerala as a measure of intellectual assessment of children of age group 6-5.11years.It was constructed in 1966 after general model of Wechsler intelligence scale for children (WISC) and comprises six verbal and five performance scales (Malin,1966).

Even though author of test claim that *"It embraces all the advantages of the original along with several improvements*", one who read a full manual wonders whether the test was constructed and manual was written in a hurry burry. Manual fail to give detailed description of each subtest and there is no clarity in writings. Many a time author writes he will describe later *"....which will be explained more in detail later...", "...for reasons to be explained later..", ... "about which we shall speak later..."*(Malin,1966).

But no such literature or published documentation is found anywhere. The Standards for Educational and Psychological Testing (AERA, APA, & NCME, 2014) demand a clear explanation of rationale, relevance; intended definition and limitation of each dimensions

measured. MISIC manual doesn't keep such standards. The test itself is out dated as new revision of WISC Vth Indian adaptation has been published by Pearson education.

These inability to find out further literature on MISIC, lead to curious searching to find out who actually Arthur.J.Malin was?. Rev Arthur. J. Malin was a veteran catholic priest of Wisconsin who was appointed to India after World War II from 1947- 1972. In 1972 he moved to Manila. Development of MISIC was his doctoral thesis. This history clearly shows why there are no further studies on psychometric properties and further improvement of MISIC.

Because of cultural biases author has done a total revision of verbal items, so he put the entire new name Malin's intelligence test for Indian children. The test was developed for English speaking child in India and he ascertains a regional vernacular adaptation will be a necessity in near future in India. Performance items will also require translation because the author himself is not sure whether the test will be sufficiently culture free for any Indian environment. This view of author contradicts authors own view that psychological principles are free of cultural bias and his quoting of V.V Kamath, *"there is nothing the mental constitution of Indian children that warrants trying to devise tests radically different from those found suitable to west"* .If the test suitable to west is suitable to India, how come a test developed for English speaking Indian population can't be used for other local languages.

Malin also critics Wechsler for scaled score and avoid use of scaled score but convert raw score directly into test quotient. Samples are drawn only from some major cities like Nagpur, New Delhi, Bombay, Shimla and Mangalore. These reductions of complete geographical area of India reduce this tests applicability for Kerala. Author criticizes his own test that high selective nature of sampling from English medium schools unavoidably contaminates construction of IQ tests. There are no separate norms for male and females.

In Information subtest there are grammer mistakes like "How many ears have you?" instead of how many ears do you have? And "How many legs has a dog?'' instead of how many legs a dog has? Most of questions are academic oriented which doesn't measure what the test intended to measure as Wechsler pointed out, "*In general, the items should call for the sort of knowledge that an average individual with average opportunity may be able to acquire for himself*", (Wechsler,1955). Criticisms we discussed above for WAIS on determining correct response and repertoire of responses for picture arrangement, comprehension and similarities subtest of WAIS are applicable to vocabulary subtest and analogies & similarities subtest of MISIC. Language and syllable issue while local translation to Malayalam is discussed in detail by Shamla and Jayan (2016) and will be applicable to Digit span test of MISIC too.

While reading this manual one automatically wonder how come a professional of Kerala apply this test to Kerala Population (even without consideration of other serious flaws mentioned above) as it is written in manual it is applicable to English speaking students only. This lead to

assumption that clinical professionals who administer Malin's test haven't read full manual. Uses of non-standardized vernacular translations done by professionals are serious ethical issue under standards of test commission.

Conclusion

Most of the adopted test had not validated or upgraded as parallel to its western donor until recently till Pearson education group and Prasad Psycho co-operation recognized the need of adaptation of revised forms. But they charge high amount for single assessment tests. Because of high cost or due to negligence to study new revised forms lead clinical psychologist of all over India to use BKT, MISIC or other such measures which they were already trained in.

Failure to develop our own assessment measures may be due to the fact that there is no institution in Kerala which offers higher research oriented programs in this area. For overcoming the failures, we have pointed out; we must encourage research in this long forgotten yet highly recommended area of intelligence testing. Intellectual assessments done in this manner is neither valid nor reliable. Many a time professional's would have to rely upon his "intuition" and "judgment". Clinicians should be conscious of culturally diverse backgrounds in understanding intelligence. Only through combined effort of test users and researchers that limitations of administering older versions of a measure can be brought to the attention of practicing psychologist. A request is made for co-operation from test developers and distributors to reduce the cost of tests to a reasonable rate, as high cost of new versions may be a limiting factor in adopting new tests for assessments.

No public criticism is made on using old versions as assessment tool by exhorted scientific research and education communities and to urgently consider replacing or re standardizing these tests. This lack of criticism shows the quality of professional instruction in the field of intelligence at local universities and on efficacy of professional ethics board for psychological testing and test commission of India, who are responsible for maintaining standard in psychometric testing. It is thus hoped that this article has made a constructive contribution to further stop assessment using older versions and outdated norms.

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Chapter -1
Revitalizing Intellectual Assessment In Kerala; a critical analysis

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Scientific exploration for testing differences in mental ability started few centuries ago. The prevailing view of differences among individuals and ways in which these differences are assessed change with time as a function of development of scientific knowledge and in terms of social and cultural setting in which this knowledge is interpreted. Given the space available for our paper, we omit much historical , cultural and scientific detail of west and significant focus is given on assessment of intelligence in Kerala.

Indian history of Intellectual Assessment

Sinha (1984) while discussing history of psychology in India observes that discipline of psychology developed primarily based on the knowledge and know-how imported from the Euro- American tradition as a part of large scale transfer of western knowledge and education. Because psychology started its journey by imitating the research problem, concepts, theories and measures from west, intellectual assessment also followed the same path. After independence history shows evidence for progress in

psychological research through indigenization.

Research in the area of psychological testing made a quantum leap after independence. Preoccupation with psychological tests is quite traditional in India. Although psychologist is working toward indigenization there persists a tendency to adapt assessment tools from west. Psychologists who were trained in mental testing tradition of Spearman were preoccupied with assessment of intelligence and in adapting intelligence tests. Scholars from north and south like Ramalingaswami (1970), Trivedi (1970), Bhatl (1972), Sheth (1979) and Joshi (1982) adapted and translated famous psychological tests which were widely used in west. U.P psychological Bureau at Allahabad established in 1947, under the leadership of C.M Bhatia and S.N Meharotra adapted many intelligence tests in Hindi. A complete review and history of adaptation of intelligence tests can be seen in Swaroopa Rani, Priyadarsaini, and Bhaskara Rao (2004) and Mangal (2007).They also comment that psychological testing in India consists of adaptations of foreign tests, with very little original contribution.

Even though tests were re-standardized to Indian culture, no one thought that Kerala culture is different from other Indian cultures. Psychologists used western assessment instruments adapted to other language speaking states of India. Psychologists of Kerala without thinking of appropriateness of items for diverse socio- cultural context started widely using them.

They have already adopted, then why do we redo again?!

A survey on use of intelligence tests showed that Binnet- kamath test (BKT) and Malin's Intelligence Scale for

Indian Children (MISIC) are two of the most tests used by clinicians and majority of them translates items/instructions into taste's native language (Shamla & Jayan ,in press). But the astonishing fact is that BKT is standardized in 1940s for Hindi, Marathi, and Guajarati speaking individuals. Original version from which BKT was adapted reached its 5th revision now. Accordingly most of other western assessment tools too.

Flynn has been credited with having discovered the increase in IQs that has been reported in a number of countries during most of the twentieth century and that has come to be known as "the Flynn effect" (Lynn, 2014). If Flynn effect is really happening then Cognitive tests adopted in 90's will be inadequate to asses' 21st centaury children. Also, cross cultural suitability of these tests cannot be assumed mainly because of the cultural and educational difference of past and present generation. This suitability is questionable and infrequently studied. Children of past generation will be unfamiliar with testing procedures and materials which is in sharp disparity with comparatively high level of test-wiseness of present generation. Popularization of IQ tests through one click availability of intelligence test in online (even though standardization is questionable) and advertisements for improving ones IQ, make today's child familiar with test items. For e.g.: working with figures and puzzles may be a novel experience for children of 19th centaury where as today's children and adults are exposed to these tasks at preschool level due to explosion of online and mobiles games. There are special android apps to improve memory power, eye hand coordination, reasoning ability, visuo-spatial ability and so on which are freely available in the market. We

know that puzzle games or comparable tasks can positively contribute to ones visual processing ability which may act as practise effect.

This is not the case of BKT alone. Most of the adopted test had not validated or upgraded as parallel to its western donor until recently till Pearson education group and Prasad Psycho co-operation recognized the need of adaptation of revised forms. But they charge high amount for single assessment tests. Because of high cost or due to non willingness to accept and study new revised forms lead clinical psychologist of Kerala to use BKT, MISIC or other such measures which they were already trained in.

In this 21st centaury too clinical psychologist simply translates assessment instruments to our mother tongue (Shamla &Jayan , in press). Failure to develop our own assessment measures may be due to negligence of ethical and scientific problems of oral translation of items or standardization issues. Another fact may be there is no institution in Kerala which offers higher research oriented programs in this area.

Is oral translation a serious problem?!

A translation of the test without the adaptations is presumably highly susceptible to instrument bias and item bias; an inadequately adapted instrument is likely to provide an underestimation of the cognitive performance of a child (Malda, et al, 2008).

Structural differences between languages make it difficult to avoid gender specific references when words automatically refers to gender in some language and in some cases it will be difficult to find semantically equivalent

words. For eg : "Friend" in English word refer to both male and female but in Malayalam *"kuttukaran"* refers to male and *"kuttukari"* refers to female. While oral translation how will we decide which to use? If we use male version for males and female version for females then we are unknowingly transferring the idea girls must have only girl friends and boys can have only boyfriends. If we argue to use both by using '/' then we are giving the testee a complex question of which word they should pick up.

Some items may refer to cultural norms, customs or practises (For e.g.: item about celebration of birthdays). If the testee is not familiar with such customs (For e.g.: some group of Muslims think it's *'haram' to* celebrate birthdays) how can we literally translate such items?

According to Baddeley's phonological loop model (Baddeley, Thomson, &Buchanan, 1975; Cowan, Baddeley, Elliott, & Norris, 2003), the number of items that can be stored in memory varies with their phonological length (such as the number of syllables).The shorter the items, the more items can be recalled. It follows from the model that Number Recall will be more sensitive to differences in memory capacity when shorter digits are used and that it is important to maintain a constant phonological digit length.

All digits in Malayalam from 1 to 9 are disyllabic, except 9, which have three syllables. In English all numbers except 7 are monosyllable. In such cases longer digit length can only be introduced later in a series .If Baddeley's theory is true how can we translate numbers in digit span without considering its phonological length? Similarity in digit length may be lost when the items are translated into another language. Any psychometrician will agree that digit

span items should ideally have digit names that are all of similar length.

Familiarity with item characteristics can also cause a problem (e.g. picture of a house or railway station may not be recognized as such by other cultures).

Language acquisition of first language and second language is different (Poshi,,&cukani,.2013;Nau.N.2014). When we translates tree as *'maram'* and ask the child to tell rhyming word for *'maram'*, knowingly or unknowingly we are ignoring the fact that child learns rhyming word *'karam'* or *'varam'* in much latter stage of language development while rhyming word for tree as free usually take place at the same stage. Only after thorough understanding of language acquisitions we can translates or adapt items with much more verbal loadings.

Same can be applicable to recall of sentences along with other criteria such as familiarity, grammatical category, and number of syllables, phonological and semantic properties.

So, do we need our own original contribution?!

It is well known that the experience of a child is bound by his culture and that an intelligence test cannot be equally fair to populations with different upbringings. Consequently, the existing measures of assessment techniques need to be up-to-date and sophisticated.

Cross-cultural research (Trimble, Lonner, & Boucher, 1983) has tried to minimize the parameters along which cultures may vary. One of these parameters is language. If cultural groups to be tested speak different languages, then

the development of a test that requires no language on the part of the subjects is necessary. Another aspect of individual assessment that may contribute to the cultural variation is related to test construction. Most non-verbal tests contain information that is valid for certain cultures. Thus, a person raised in a certain culture may lack the background of experience to respond correctly to these items. Kerala culture is sophisticated and complex and different in many other respects too. Children of Kerala are exposed to very different educational and material environments at home and school

The Indian Human Development Report, 2011 prepared by Institute of Applied Manpower Research, placed Kerala on top of the index for achieving highest literacy rate, quality health services and consumption expenditure of people. In 2001, Kerala's literacy rate was 91% almost as high as that of China (93%) and Thailand (93.9%). Kerala model development reflected in indicators of social development, made Kerala comparable to those of many developed countries. These reports support our argument that Kerala milieu is entirely different from other non Malayalam speaking states of India. If this is the situation, then is it fair to use Indian adapted tests (if norms do not includes samples from Kerala) with Kerala population. As far as the author knows, there is no standardized intelligence test that can be used for Kerala people especially for screening of disabled children. One and only mental ability test is by George Mathew which is not used in clinical setting.

Malda, et al, (2008) while discussing different types of adaptation processes also explains about construct driven adaptation which is related to differences in definition of

psychological concepts across culture. This pose a serious question before us , if our aim is to measure "intelligence" , then, is the test adapted according to target cultures definition of intelligence?

Study by Srivastava & Misra, (2007) on lay people's understanding and use of intelligence found there are four aspects of intelligence, cognitive competence , social competence, entrepreneurial competence and emotional competence. In Indian context all four of competence is seen as interconnected whole and a person should possess it in proper proportion and should use them accordingly. This study claim to symbolize Indian population including samples from Mysore to represent south India. But they haven't included samples from Kerala. If such is the case in India it's important to study Kerala's mind too. Unfortunately there aren't any such studies.

Wrapping up.

Finally, this review indicates the crucial importance of combining expertise of Linguistic, psychometric, child development, intelligence and cultural knowledge while adapting or constructing an intelligence test. Like Malda,& et al, (2008) pointed out, Knowledge from other informants such as parents (to provide information on the child's cognitive stimulation at home) and teachers (to provide information on the school curricula and teaching strategies) will also be fruitful. But at present we could see a neglect of proper conceptualization of theoretical base and absence of higher order rigor in methodology.

In sum, this paper has attempted to trace the history and present scenario of use of intellectual assessment of

Kerala. Intelligence testing will continue by psychologists and rehabilitation professionals. It's also a humble submission to all professionals who works in the field of diagnosis, management and remediation of children with special needs to pose and think aloud. This paper also calls for new avenues of research- albeit differently.

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