V. SUMMARY AND CONCLUSION

Academic Achievement (AA) portrays the academic outcome that indicates the extent to which students have attained their educational goals. Beyond the level of school achievement, AA is also important for their successful development in society in the coming years. Children performing well in school are better equipped to make the transition into adulthood and to achieve occupational as well as economic success (Organization for Economic Co-operation and Development, 2022). To perform well academically, children must be made aware of not just their intelligence level but also the kind of intelligence that each possesses (Batdi, 2017). It is here that the Multiple Intelligence (MI) construct gains significance. Research carried out by Vadivukarasi and Gnanadevan (2022), Ahvan and Pour (2016), and Pérez (2014) further confirms that MI significantly predicts AA in school children. Learning Styles (LS) is concerned with how the learners learn rather than what they learn and are believed to be a crucial factor for students' AA (Gokalp, 2013). Accordingly, the research of Singh and Cutting (2018), Bethel and Eremie (2017), and Rajshree and Vaishnav (2013) authenticates a significant relationship between LS and AA in secondary school students. More so, Yasin (2020) has stated that a well-thought-out Teaching Pedagogy (TP) is essential in aiding school children to learn more effectively and develop thinking skills of higher order. Certain studies carried out by Farooq et al. (2022), Yasin (2021), and Ganyaupfu (2013) affirm the same.

With the realization of the importance of MI, LS, and TP on AA in school children a question of their interrelationship with each other was raised. Few studies that found an interrelationship between MI and LS were found as cited by Nastor (2016). The present study not only aimed to find their interrelationship but unlike other studies, wanted to move a step further to formulate a suggestive model for AA by identifying the predictive capacity of MI and LS possessed by school children and TP practised by the teachers. Accordingly, four major research gaps were identified i) Studies collated are only individual studies correlating one predictor (Either MI or LS or TP) with AA. No one study links all the predictors with AA ii) There aren't any studies addressing the formative age group crucial for MI and LS (11 – 15 years) iii) The studies on AA were on overall AA, but not on subject-wise AA, though found was scant and iv) There aren't any studies related to the Samacheer Kalvi Syllabus (a Unified approach of the state of Tamil Nadu) followed by the schools in Tamil Nadu.

Hence, the present study aimed to formulate a suggestive model for subject-wise AA of school children by identifying the predictive capacity of MI and LS possessed by school children and TP practised by their teachers. Henceforth, the predictive models devised could serve as a base for curriculum developers, teachers, and school administrators to provide a pleasant learning environment to the students. Accordingly, the objectives are

***Primary objective*:** To formulate predictive models for subject-wise Academic Achievement (AA) of school children enrolled in Samacheer Kalvi (Tamil Nadu Unified System of Education) integrating Multiple Intelligence (MI) and Learning Style (LS) possessed by the students and Teaching Pedagogy (TP) practised by the teachers

Secondary Objectives:

- ✓ To assess the subject-wise AA of the selected student respondents
- ✓ To determine the influence of socio-demographic variables on AA of the selected student respondents
- ✓ To assess the level of MI of the selected student respondents
- ✓ To determine the influence of socio-demographic variables on MI of the selected student respondents
- ✓ To assess the various types of LS of the selected student respondents
- ✓ To determine the influence of socio-demographic variables on the LS of the student respondents
- ✓ To assess the levels of TP of the selected teacher respondents
- ✓ To determine the influence of personal profile on the TP of the selected teacher respondents and
- ✓ To formulate a suggestive framework for subject-wise AA with positive and negative predictors in terms of MI and LS of students and TP of teachers

METHODOLOGY

A descriptive cross-sectional research design was adopted and the study was carried out in Coimbatore, an educational hub of Tamil Nadu. The schools in Coimbatore were of three types – Government schools (run by the Tamil Nadu Government), Aided schools (funded by the government but run by private trusts), and Private schools (schools funded entirely by private organisations). To get a fair representation for the research the schools located within 5 km from the heart of the city, following the Samacheer pattern of syllabus

were shortlisted from the four zones. Accordingly, a total of 30 schools were shortlisted representing all 4 zones, wherein 18 schools extended their willingness. A total of 3026 school children enrolled in classes 6, 7, and 8 constituted the sample along with the 215 teachers handling classes for these children.

A total of four tools were used to get the necessary data from school children namely i) a self-formulated general background questionnaire to get the personal and parental profile of the school children ii) a standardised Multiple Intelligence Scale developed by Agarwal & Pal, with 90 statements in 9 domains of intelligence (Linguistic, Logical, Bodily-Kinesthetic, Spatial, Musical, Naturalistic, Interpersonal, Intrapersonal, and Existential) iii) a standardized Learning Style Inventory developed by Misra, with 42 statements in 6 styles of learning (Enactive Reproducing (ER), Enactive Constructive (EC), Verbal Reproducing (VR), Verbal Constructive (VC), Figural Reproducing (FR) and Figural Constructive (FC) iv) Likert Scale to assess the subject-wise Academic Achievement (secondary data procured from the student's report cards) The average marks of five major subjects (Language, English, Mathematics, Science and Social science) in the five major exams conducted in an academic year were categorized using the commonly used grading system of the schools of Tamil Nadu. A total of two tools were used to elicit data from the teachers i) a self-formulated questionnaire to elicit the academic profile of the teachers and ii) a standardised Teaching Style Scale developed by Sharma and Saran with 60 statements in 5 types of teaching pedagogy (Expert, Formal Authority, Demonstrator, Facilitator, and Delegator). The grades and norms specified by the standardised tools were adhered to for further computations. The collected data were statistically computed using frequency analysis, t-test, ANOVA, and hierarchical regression.

KEY FINDINGS

A. Personal Profile of Respondents

a. General profile of the student respondents

- ✓ Class-wise distribution - 34% of the respondents were in class 8, closely followed by classes 7 and 8.
- ✓ Gender-based distribution - Girls had a higher representation of almost 52% when compared to their counterparts.

- ✓ Type of family - 60% of them were from nuclear families, 27.9% from joint families, and the remaining from extended families.
- ✓ Type of school - Most of the respondents were from aided schools (45.5%) followed by private schools (39.4%). 15.1% were from government schools.
- ✓ Birth order - More than half were first born (51.9%), followed by 39.9% middle born. 8.2% were last born.
- ✓ Area of residence 45% were from semi-urban, 34.8% and 20.6% were from urban and rural areas respectively.
- ✓ Educational status of parents - 34% of the fathers and 36.3% of the mothers were 10^{th} passed, 31% and 28% were graduate fathers and mothers, and 13.5% and 10.5% were postgraduate fathers and mothers.

b. Personal Profile of the teacher respondents:

- ✓ Age - 46% of the teacher respondents were in the age ambit of 36 to 45 years age group, 33% in 25 to 35 years, and 21 % in 46 to 55 years.
- ✓ Female respondents (82%) were more than the male respondents.
- ✓ Educational Qualification - 45% were PG with B.Ed. $1/4^{th}$ were postgraduates and 14% were graduates with B.Ed.
- ✓ Subjects Handled - English teachers were more in number (31%), followed by teachers handling Mathematics, Science, and Social Science.
- ✓ Teaching Experience - A ratio of 1.5:1:2 of three categories of teaching experience namely 1-6 years, 6-10 years, and more than 10 years was observed.
- ✓ Type of School - 51% work in aided schools, 36% in private schools, and 13% in government schools.

B. Academic Achievement (AA)

a. Categorization of the student respondents based on their subject-wise AA:

More than one-fourth of the children were under the below-average category in English (31.1%), Mathematics (30%), and Science (32.5%). In Language alone, 35% of them were found to be in the very good category. Very few of them were under the excellent and outstanding category (less than 5%). In the core subjects namely Mathematics and Science nearly 20% of the respondents' score was low.

b. Association between sociodemographic variables and AA of student respondents

- ✓ Gender showed a significant mean difference in English with *t* (2955)=2.775, *p*=.006 and Science with t(2995)=-2.549, *p*=.011. The mean score showed that boys exhibited higher scores in English and girls displayed higher scores in Science.
- ✓ Class-of-study displayed a significant mean difference in Language with *F*(2,3023)=3.744, *p*<.024; English *F*(2,3023)=21.286, *p*<.001; Mathematics *F*(2,3023)=49.454, *p*<.001and Science *F*(2,3023)=54.540, *p*<.001. The result of post hoc analysis revealed that the class eight students had better AA in all subjects when compared to their counterparts.
- ✓ The father's education was significantly influencing the AA in Mathematics alone with *F*(3,3023)=6.929, *p*<.001. The result of post hoc analysis displayed that children of graduate fathers have better AA when compared to their counterparts.
- ✓ The mother's education had an impact on the child's AA in two subjects namely Language {*F*(3,3023)=4.451, *p.*<001} with children of 12^{th} pass mothers and Science {*F*(3,3023)=7.953, *p*<.001} with children of 10^{th} pass mothers having a better score.
- ✓ The type of family was found to not influence the subject-wise AA.
- ✓ The type of school had a significant impact with Language *F*(2,3023)=6.379, *p*<.002; Mathematics *F*(2,3023)=60.604, *p*<.001; Science *F*(2,3023) = 52.483, *p*<.001 and Social Science *F*(2,3023)=7.674, *p*<.001. The result of post hoc analysis revealed that children studying in government schools had better AA in all these subjects.
- ✓ The birth order had a significant impact on AA in two subjects namely Mathematics - *F* (2,3023) =3.809, *p*<.022 and Science *F*(2,3023)=10.315, *p*<.001. The result of post hoc analysis revealed that middle-born children exhibited better AA
- ✓ The area of residence emerged as a significant influencing factor for all five subjects and the pair-wise comparisons revealed that children residing in the semi-urban areas had better AA.

C. Multiple Intelligence (MI)

a. Categorization of the student respondents based on their level of MI:

The majority of the respondents possessed an average level of MI in seven out of the nine domains namely - Linguistic, Logical, Spatial, Musical, Naturalistic, Interpersonal, and Existential. Bodily-kinesthetic (35.5%) and Intrapersonal intelligence (35.9%) alone showed more children at the above-average level. Less than 1.5% had extremely high levels irrespective of the type of MI.

b. Association between sociodemographic variables and MI of the student respondents

- ✓ Gender showed a significant mean difference in Linguistic MI alone {t(3024)=4.548, p<.001} with boys exhibiting higher score.
- ✓ Class-of-study and type of family were found to not influence the MI.
- ✓ The father's education was significantly influencing Logical MI alone with F(3,3023)=3.197, p<.023, wherein the pair-wise comparisons showed that children of graduate fathers had better Logical intelligence when compared to their counterparts.
- ✓ The mother's education had a significant impact on the child's MI in almost all intelligence except Logical and Naturalistic intelligence. The result of post hoc analysis showed that children of 10th-pass mothers had better MI in six domains except for Linguistic intelligence, wherein the children of postgraduate mothers were better.
- ✓ Type of school was a significant influencing factor for almost all the intelligence except Logical. The result of post hoc analysis revealed that government school children had better MI except for Linguistic intelligence, in which the private school respondents were better off.
- ✓ The birth order had a significant impact on the child's MI in three domains namely Spatial {F (2,3023)=3.137, p<.044; Interpersonal F(2,3023)=6.038,p<.002; Intrapersonal F(2,3023) =3.077, p<.046} with middle born respondents acquiring better scores.
- ✓ Area of residence had a significant impact on the child's MI in Linguistic, Bodily-Kinesthetic Interpersonal, and Intrapersonal, where the urban children showed better Linguistic intelligence and semi-urban children in other domains.

C. Learning Style (LS)

a. Categorization of the student respondents based on LS:

A majority of the respondents fall under the average level category in all types of LS. Less than 5% of them possess extremely high levels of LS with the exception being the FC (22.3%) and FR (36.4%).

b***. Association between sociodemographic variables and LS of the student respondents***

- ✓ Gender showed a significant mean difference in VR with t (3024)=2.255, p<.028, where boys were better than their counterparts.
- ✓ Class-of-study displayed a significant mean difference in ER {F(2,3023)=3.235, p <.040}, VR {F(2,3023)=4.978, p<.009}, and VC {F(2,3023)=3.272, p <.038}. The

result of post hoc analysis revealed that class 8 students had better ER and VR whereas the class 7 students had an augmented score in VC.

- ✓ The father's education and type of family were found to not influence the LS.
- ✓ The mother's education had a significant impact only on FR {$F(3,3023) = 8.847$ $p<.001$}, where the children of 10th-pass mothers displayed higher scores.
- ✓ Type of school and area of residence were significant influencing factors for all LS except VC. Further analysis showed that private school children use VR very often when compared to their counterparts, whereas the government school children had better scores in all other LS. Similarly, the children from the semi-urban area had an augmented score in all LS.
- ✓ The birth order had a significant association with VR {$F(2, 3023) =3.864, p<.021$}, wherein the middle born were good at VR.

E. Teaching Pedagogy (TP)

a. Categorization of the teacher respondents based on TP:

More than 60%t of the teachers exhibited an average and above-average level of practice in all five TPs (Expert, Formal authority, Demonstrator, Delegator, and Facilitator). Very few were found to practice the identified styles either at the extremely high or extremely low level. However, the Delegator TP at a high level was noticed among 17.5% of the teachers followed by Demonstrator TP (13.5%).

b. Association between personal profile variables and TP adopted by the teacher respondents

Age, gender, type of school, and the subject handled were found to not influence the TP of the teacher respondents. The Educational qualification significantly influenced the TP concerning Demonstrator style $F(4,214)=2.841$, $p<.025$, where the graduate teachers with B.Ed scored better. The teaching experience significantly influenced TP in Formal Authority with $F(3,214)=2.948, p<.032$, and the teachers with 6-10 years scored better.

F. Predictive Models Integrating of MI, LS and TP

To formulate the predictive model, the three assumptions that were considered were (i) MI influences subject-wise AA, (ii) LS influences subject-wise AA and (iii) TP also influences subject-wise AA. To verify these assumptions, the variables were entered into three blocks, to compute their predictive capacity in the hierarchical regression analysis. The variables were entered in the order of MI, then LS, and finally, the TP as it

seemed chronologically plausible given that MI describes the way the students learn and acquire the information, LS is the way that the students choose to learn and TP is the strategy adopted by the teachers to engage the students in the learning process. Accordingly, five predictive models one for each subject were derived.

a. Predictors of Academic Achievement in Language

With nine domains of MI included in model 1, the variables explained 0.7% variance with the Naturalistic MI being the positive predictor and Existential the negative predictor. The second model (after adding six types of LS) explained just 0.8% variance with none of the LS having a significant relationship with the AA in Language. The final model (after adding five types of TP) explained an overall 1.8% variance in the outcome variable with the Naturalistic MI and Expert TP emerging as positive predictors whereas, Existential MI, Formal Authority TP and Demonstrator TP as negative predictors.

Hence the fit model for AA in Language = 62.76 (β0) + .081 (Expert style) + .075 (Naturalistic MI) –.090 (Existential MI) -.059 (Demonstrator) –.043 (Formal Authority).

b. Predictors of Academic Achievement in English

When the nine domains of MI were included in model 1, the variables explained 0.5% variance and none of the MI showed a significant relationship. The second model (after adding six types of LS) explained 1.0% variance and displayed that the FR had a negative significant relationship with the outcome variable (AA in English). The final model (after adding five types of TP) explained an overall 3.1% variance in the outcome variable with Facilitator TP and Formal Authority TP emerging as positive predictors whereas, FR in LS, Expert TP, and Delegator TP as negative predictors.

Hence the fit model for AA in English = 60.39 (β0) + .045 (Facilitator TP) + .042 (Formal Authority TP) – .138 (Delegator TP) – .070 (Expert TP) – .069 (FR in LS)

c. Predictors of Academic Achievement in Mathematics

When the nine domains of MI were included in model 1, the variables explained 4.8% variance with Logical, Spatial, Naturalistic, and Intrapersonal MI being positive predictors whereas linguistic and existential as negative predictors. The second model (after adding six types of LS) explained a 5.8% variance to the outcome variable (AA in Mathematics). The Logical, Spatial, Naturalistic, Intrapersonal MI and ER of LS are positive predictors whereas Linguistic, Existential MI, and FR of LS as negative predictors. The final model (after adding five types of TP) explained 11.7% variance to the outcome variable with the positive and negative predictors shown in the fit model.

The fit model for AA in Mathematics = 85.9 (β0) + .093 (Logical MI) + .069 (Spatial MI) +.091(Naturalistic MI) + .119 (Intrapersonal MI) +.071(ER of LS) +.112 (Delegator TP) – .203 (Linguistic MI) – .114 (Existential MI) – .055 (FR of LS) –.094 (Formal Authority TP) –.068 (Demonstrator TP) –.251(Facilitator TP).

d. Predictors of Academic Achievement in Science

When the nine domains of MI were included in model 1, the variables explained 7.7% variance with Logical, Spatial, Naturalistic, and Intrapersonal being positive predictors whereas Linguistic and Existential as negative predictors. The second model (after adding six types of LS) explained that 8.6% variance (Logical, Spatial, Naturalistic, Intrapersonal, and ER of LS are positive predictors whereas Linguistic and Existential MI, FR, and VC of LS as negative predictors). The final model (after adding five types of TP) explained an overall 15.5% variance in the outcome variable with the positive and negative indicators as shown in the fit model.

The fit model for AA in Science = 59.90 (β0) + .104 (Logical MI) + .077 (Spatial MI) +.076 (Naturalistic MI) + .138 (Intrapersonal MI) +.054 (ER of LS) +.048 (Expert TP) + .115 (Facilitator TP) – .275 (Linguistic MI) – .151 (Existential MI) –.042 (VC of LS) – .046 (FR of LS) –.228 (Formal Authority TP)

e. Predictors of Academic Achievement in Social Science

When the nine domains of MI were included in Model 1, the variables explained 0.8% variance with Intrapersonal MI being the positive predictor and Linguistic MI as a negative predictor. The second model (after adding six types of LS) explained a 1.1% variance to the outcome variable (AA in Social Science). The final model (after adding five types of TP) explained a 1.9% variance in the outcome variable with Intrapersonal MI and Facilitator TP as positive predictors and Linguistic MI and Demonstrator TP as negative predictors. None of the LS had a significant relationship with the outcome variable, Social Science.

The fit model for AA in Social Science = 57.28 (β0) + .103 (Intrapersonal MI) + .087 (Facilitator TP) – .077 (Linguistic MI) – .048 (Demonstrator TP)

G. Suggestive Academic Achievement (AA) Framework for Samacheer Kalvi

The suggestive AA framework derived from the predictive models formulated through hierarchical regression integrating the student-related constructs (MI and LS) and teacher-related construct (TP) suggests the following:

- ✓ ***Language (Regional language, Tamil)***: Naturalistic MI of a student with an Expert style of instruction facilitates better learning in terms of marks obtained. However, Language teachers need to use the Formal Authority and Demonstrator style of instruction to the minimum level possible.
- ✓ ***English:*** AA in English was found to be not influenced by any type of MI. However, the student's FR type of LS and the teacher's Expert and Delegator style of instruction are to be at its minimum. Also, the framework suggests that English teachers adopt a good level of Formal Authority and Facilitator type of TP.
- ✓ ***Mathematics:*** Learning Mathematics gets enhanced with an increase in students' Logical, Spatial, Naturalistic and Intrapersonal MI while adopting the Enactive Reproducing type of LS. The framework suggests the teacher be a Delegator while teaching Mathematics and cautions them to use Formal Authority, Demonstrator and Facilitator type of instruction at a minimal use. The Linguistic MI and FR of LS do not help in learning Mathematics
- ✓ ***Science:*** AA in Science follows a similar trend with that of AA in Mathematics in terms of student-related factors except for an additional LS namely VC which was found to destroy Science learning. However, the TP to be used was completely different in suggesting that an Expert and a Facilitator type of instruction could enhance the student's ability to learn Science. Moreover, the use of Formal Authority TP was not entertained.
- ✓ ***Social Science:*** AA in Social Science was found to be enhanced when a student has a good Intrapersonal MI and a teacher adopts the Facilitator type of instruction. However, the framework suggests that Linguistic MI and Demonstrator TP will have a negative impact.

CONCLUSION

The study revealed that more than 50% of the children had only average and above-average levels of AA in almost all subjects except Language. However, 60 -70% of the respondents were observed to possess average and above-average levels in all domains of MI. In terms of LS, except for FC, all other types of LS were practised only at an average level. The five types of TP as practiced by the selected teachers were in the average and above average levels. However, delegator TP was practised at a high level (17.6%) when compared to other teaching pedagogy. Among all the socio-demographic factors pertinent to school children, the type of family was found to be an independent factor for AA, MI,

and LS. The father's educational status was the next least influencing factor. The experience and the educational qualification of teachers were found to influence the formal authority TP and demonstrator TP respectively.

The five predictive models of a good fit for AA derived, in each of the subjects provide the following clues in terms of positive and negative contributors to AA. i) Logical, Spatial, Naturalistic, and Intrapersonal types of MI positively predict the AA of one or the other subjects. Likewise, in terms of LS, only ER influences AA on a positive note. In terms of TP except for the demonstrator, other styles predict the AA of one or more subjects ii) The higher the Linguistic and Existential MI, the lower the AA. Similarly, VC and FR were negatively contributing to the AA. Demonstrator TP negatively influences all subjects except English and Science.

All the more, the predictive models also suggest some of the non-contributing factors and cautious factors to AA. i) Bodily-kinesthetic, Musical, and Interpersonal domains of MI; EC, VR, and FC of LS were the non-contributing factors as they did not show any relationship with AA. ii) the cautious predictors are factors that have both positive and negative values and are to be taken care of for the respective subjects. For example, Formal Authority TP which was found to positively predict AA in English was negatively predicting Language, Mathematics, and Science learning. Similarly, Facilitator TP that positively predicts AA in English, Science, and Social Science was found to be negatively influencing Mathematics learning.

RECOMMENDATIONS

The findings of the study put forth strong recommendations for the following entities:

***School administrators*:** The subject-wise fit predictive model and suggestive framework encompassing MI, LS, and TP, thus derived from the study would help the school to promote programmes and workshops for students to strengthen the needed MI and LS. For instance, fostering Logical and Spatial intelligence is necessary for better math and science learning. Furthermore, these models would also serve as an indicator for the administrators to formulate professional development programmes for teachers to identify the dominant TP used by them and offer strategies to adjust their TP based on the subject that they teach.

Teachers: As the findings of the study provide a clear mandate for teachers in terms of the predictive MI and LS for each of the subjects, mapped with their TP, a directed plan of the lesson and focused teaching-learning activities could be devised. For example, the

teaching-learning environment with limited use of Demonstrator TP by the teacher mapped with fostered Naturalistic intelligence and ER of LS of the children results in better Social Science scores.

Students: The students would be able to analyse their dominant MI and preferred LS. With this awareness, reflective learning would be made possible to develop their strengths and overcome weaknesses, thereby making their learning process enjoyable.

***Curriculum developers and Policymakers of school education*:** The five predictive models and suggestive framework serve as a credible reference for the subjects offered in the Samacheer Kalvi. The curricular framework is recommended to provide clues for the teachers to adopt certain TP, enhance the MI, and alter the LS of the students. For instance, the curricular framework on the Subject Language should encompass a plan of instruction predominantly using Expert TP and minimal use of Formal Authority and Demonstrator TP. Similarly, learning experiences provided in the framework are to provide inklings to develop naturalistic intelligence in the students.

Future researchers: Future research can be directed in three ways 1. The results portrayed the ER of LS as a positive predictor for Mathematics and Science learning, and it seems to be contradictory to its characteristics. This poses the question of why the Samacheer Curricular Framework necessitates only ER. Where does this problem get positioned? Is it in the planning or implementation or the evaluation phase? 2. Testing of the five fit models for AA encompassing MI, LS, and TP in the actual field would validate the model. 3. Such models need to be formulated with the other boards of education.