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Abstract
In Malaysia, literature relating to the efficacy of STEM learning has been limited to secondary or tertiary levels, and remains more popular among the school populations. However, in terms of the influence of social support on the development of learners' STEM efficacy (SE), the fathers' impact has been neglected. To bridge this gap, this study explored the influence of fathers' support on SE. Based on theoretical insights, hope was included as a mediator to hypothesise a potential underlying process that determines the relationship between fathers' support and SE. This was a quantitative study that employed a correlational research design. It involved 548 young adolescents aged 9 to 11 years, who studied in government primary schools, and lived in the Klang Valley. Regression analysis using Structural Equation Modelling (SEM) showed that fathers' involvement (b=.284, p=.002), and structure support (b=.275, p=.000) uniquely predicted SE, but had no effect on autonomy support. Hope significantly mediated the relationships between involvement and SE, and between autonomy support and SE, but showed no mediating effect on structure support. This study offers several implications. First, it unfolded hope as a significant underlying factor mediating the relationships between fathers' support and SE. Second, it expanded the literature on fathers' support and SE with the population of young learners. Lastly, by revealing the predictors of SE as well as the mediating role of hope, this study provides implications for future STEM educational planning at the primary school level in Malaysia.
Keywords: Fathers' Support, Hope, STEM Efficacy, Young Adolescents

Introduction

Malaysia has sought to improve its education system in preparing the young generation to face global economic challenges by launching the National Education Blueprint 2013-2025. As a solution, STEM education was introduced in 2017 as part of the curriculum in primary and secondary schools in hopes of nurturing more competent learners in the fields of science and engineering (Bahrum et al., 2017). In the primary schools, STEM education included mathematics, the sciences, and ICT/design and technology (Chong, 2019). It is taught for 4 hours, 3.5 hours, and 1.5 hours weekly, respectively, employing an integrative teaching and

learning approach (e.g., problem-solving, and knowledge-application based). However, a review of local STEM studies found that those targeting young students were limited (Jayarajah et al., 2014). Similarly, the literature on STEM efficacy is currently limited to secondary and tertiary education levels (Luo et al., 2020), and showed variations in the use of STEM efficacy measures, including advanced STEM concepts that are beyond the comprehension of young learners. In fact, a meta-analysis even revealed no empirical interest in the STEM efficacy of local learners as, to date, the issues addressed have revolved around pedagogy, resources, teaching and learning perspectives, interest, and motivation (Jayarajah et al., 2014).

In light of Social Cognitive Theory, Bandura (1997) mentioned that efficacy is derived from social context, where family, the school, and socio-cultural factors are the three main resources. Within the family context, efficacy scholars have consistently discovered that supportive parents tend to raise efficacious learners (e.g., Hwang & Jung, 2020; Liu et al., 2019; Otto & Karbach, 2019). However, these studies focused on overall parental support without specifying gender roles. Nevertheless, even with further meta-analysis of available studies focused on gendered parental issues, there was greater attention on the mothers' influence than fathers' (Jeynes, 2016). Despite that, in several limited studies, fathers' parental role in adolescents' academic development was highlighted as more important than mothers' (Kim & Hill, 2015; Lv et al., 2018; Yahya et al., 2019), and that it also significantly benefitted learners' learning, for example, by reducing math anxiety (Demirtaş & Uygun-Eryurt, 2020), and improving math grades (Bartley & Ingram, 2018). However, these studies utilised different father and academic factors, making the findings less comparable. Therefore, further research is needed.

Theoretical Framework of Self-Efficacy and STEM Learning

Three theories were employed to support the current research settings. They are the Overlapping Spheres of Influence (Epstein, 2018, 2019), Social Cognitive Theory (Bandura, 1977), and Hope Theory (Snyder, 2000).

Overlapping Spheres of Influence

Epstein's (2019) Overlapping Spheres of Influence (OSI) model integrates sociological, psychological, and educational viewpoints to emphasise the essentiality of partnerships among three social institutes: family, school and community, with regards to children's educational needs. OSI believes that the members of these institutions have the same joint interest in facilitating learners' academic success, and that such goals are best achieved through collaborative action and support (Epstein, 2018). Besides that, Epstein (2019) highlighted that, although learners play a main role in their own education, it is the active partnerships among parents (mothers and/or fathers), teachers, and students, not only family and school, that assist to involve, educate, inspire, and motivate learners to attain specific goals.

There has been consensus among adolescent studies that support from social agents (for example, at home and school) helps to determine learners' academic behaviours and attitudes, hence, promoting learners' success in school (Epstein, 2018). Their support usually includes actively and regularly providing learners with academic assistance in both physical (e.g., providing academic opportunities, tools, and homework supervision, etc.) and psychological forms (e.g., communicating aspirations, empowering, inspiring, etc.) (Johnson, 2015). These are important sources for the development of efficacy (Schunk & Mullen, 2012).

Social Cognitive Theory (SCT)

Traditionally, the conceptualisation of self-efficacy has been largely based on Albert Bandura's Social Cognitive Theory (SCT). In an educational context, Bandura (1977) defined academic efficacy as a person's appraisal of their own abilities to perform and manage desired actions that could help accomplish certain educational goals.

On the other hand, efficacy belief is a multi-dimensional construct (Zimmerman, 1995), and hence, different efficacy domains function distinctively in adolescent development. For example, those who have high English efficacy may not necessarily possess the same in science learning. Likewise, those reporting high efficacy in science subjects may demonstrate a different efficacy in STEM tasks. As mentioned by Luo et al. (2020), STEM efficacy is different from that of the traditional science disciplines (science, mathematics, etc.) as it involves additional skills in applying science knowledge (e.g., innovativeness, creativity, problem solving, etc.). This signified the need to distinguish STEM efficacy from other efficacy variables.

STEM-related efficacy has typically been measured in several ways. Some scholars focused on efficacy in STEM-based subjects, for example, mathematics (Rozgonjuk et al., 2020), science (Lee et al., 2008; Lin & Tsai, 2013; Razali et al., 2017; Wong et al., 2019), and engineering (Syed et al., 2019). Other scholars preferred to measure STEM efficacy integratively, either measuring global STEM perceptions (subjective feeling) (Meng et al., 2014), or combining two or more STEM subjects or aspects (Luo et al., 2020).

In STEM education, self-efficacy was found to be an important motivational factor in preserving learners' STEM interests, learning, and careers (Luo et al., 2020; Mohd Shahali et al., 2019). As mentioned in SCT (Bandura, 1997), efficacious learners tend to possess positive emotional states (e.g., less anxiety, stress, or depression), thus resulting in better academic coping behaviours. Conversely, perceived low self-efficacy in performing STEM tasks leads to hesitation in STEM learning (Falco & Summers, 2019).

Based on SCT, self-efficacy is deeply rooted in the social context, and derived from the reciprocal interactions of three determinants: personal, behavioural, and environmental factors (Bandura, 1997). These interaction processes have resulted in four main sources for the development of efficacy, namely performance mastery, social persuasion, modelling experiences, and emotional state. Many scholars claimed that learners developed their efficacy mainly from people they trust, such as their parents (e.g., Schunk & Mullen, 2012; Yap & Baharudin, 2016).

Hope Theory

Hope Theory (HT) was developed by Rick Snyder (1944-2006). Snyder et al (1997) postulated that children's hopeful thinking is a kind of positive expectancy, where those with high hopes generally believe that they can achieve all their goals. Having such a hopeful mind is believed to positively affect children's functioning in academics, for instance, stress regulation, and coping abilities. Specifically, children's hope comprises two components: agency (belief in initiating and preserving their drive in attaining certain goals), and pathways (belief in finding alternative routes for success). Snyder (2002) highlighted social support as the source of hope, and hopeful thinkers as social creatures. Early experiences with trusted social agents are viewed as key to cultivating learners' hopeful minds, and assisting them in developing other essential skills for their success in life (Snyder et al., 1997), for instance, academic efficacy (Demirtaş, 2019; Gungor, 2019).

Integration of Theories

Bandura's (1997) SCT conceptualised self-efficacy as deeply rooted in the social contexts in which an individual resides, and that familial, sociocultural, and educational environments are the three determinants in self-efficacy. However, the specific roles of these social factors are less described. To expand on the SCT, the OSI model was used to explain how fathers' support (at the home level) is a crucial factor in their adolescents acquiring certain skills required by schools (like academic efficacy). Their support demonstrates their shared interest (with the school) in helping their adolescents gain success in academics and life.

In adolescent research, internal factors have been found to be powerful determinants of their academic outcomes. Both SCT and OSI mentioned that family variables are likely to facilitate this internal growth process. HT was used to encompass this thought, whereby pleasant parent-child interactions, and family climates are likely to nurture hope, which is associated with better academic control and competence among learners. Hence, in the present study, hope was employed to link fathers' support, and development of self-efficacy. Incorporating the HT with the other two subsequently highlights hope as a psychological determinant that works to internalise the messages obtained from fathers in the nurturing of self-efficacy (STEM) in learners.

Fathers' Support and Adolescents' Academic and STEM Learning

Traditionally, fathers are viewed as breadwinners and disciplinarians, and their parenting tends to be more goal-oriented, and focused on communicating life and future aspirations to their children (Suizzo et al., 2017). Unlike mothers, who are often described as more nurturing and emotionally supportive, fathers are often viewed as cooler, and less tolerant (Jeynes, 2016). Literature on fatherhood and adolescents' academic development is currently lacking in both Western and cross-cultural research (Suizzo et al., 2017). As explained in a meta-analysis study, this is because fathers are not viewed as the main player in the children's education (Kim & Hill, 2015). Likewise, another meta-analysis claimed that, despite the fathers' parenting having unique contributions to the adolescents' psychological, social, and academic development, the mothers' influence continues to receive more attention (Jeynes, 2016). Jeynes (2016) explained that fathers' parenting is more goal-specific, and prepares their children to deal with life's challenges, and for future success. Therefore, their parenting is usually important for future cognitive functioning, helping learners to possess better control and attitudes in academic learning. Likewise, Kim and Hill (2015) mentioned that, although fathers may be less involved than mothers, their influence on learners' academic development is as strong as the mothers'. Jeynes (2016); Kim and Hill (2015) have highlighted that these distinctive parental roles of fathers and mothers are necessary as they hold different functions in determining learners' academic achievement.

A detailed investigation of past literature found that fathers' influence on adolescents' academic development showed mixed results. Some scholastic evidence suggest that the fathers' influence is stronger than mothers'. For example, Graziano et al. (2009) and Lv et al. (2018) found that only the fathers' academic support (e.g., homework assistance, aspiration sharing, etc.) significantly predicted adolescents' academic efficacy, but not mothers'. Two other studies found that only fathers' control uniquely predicted academic control among American college students (Hwang & Jung, 2020), and their involvement (e.g., in homework supervision, and control) predicted the learners' grades (Lan et al., 2019). Though these studies suggest the significant influence of fathers, their findings showed variations in their predictive power. Compared to Western studies, two Chinese ones (Lv et al., 2018, and Lan

et al., 2019) reported a greater fathers' influence. In the Chinese context, fathers are usually more intensely involved in their children's academics than mothers; thus, learners may relate more strongly to fathers as their academic reference (Lan et al., 2019).

Another Turkish study, however, reported that mothers' support was more important in reducing learners' math anxiety (Demirtaş & Uygun-Eryurt, 2020). In contrast, a Malaysian study claimed that both parents' involvement predicted high school learners' academic efficacy, with mothers showing a greater influence (Yap & Baharudin, 2015). In collectivist societies where mothers are the dominant caregivers (Hossain, 2014), their involvement in the children's life is extensive, and they are also committed to fostering their academic growth (Demirtaş & Uygun-Eryurt, 2020). Therefore, in this sense, mothers are more influential than fathers.

To explain the discrepancies in the findings, Lv et al (2018) claimed that parental variables are culturally sensitive, and suggested examining gendered parental roles in light of specific parental norms and cultural insights. To date, most studies on gendered parental roles are based on individualist societies (Jeynes, 2016), and their findings conflict with those done in collectivist ones, particularly on the predictive effects, and effectiveness of the fathers' support in nurturing adolescents' academic functioning. Hence, this warrants further investigation.

In Malaysia, investigations on the impact of fathers on adolescents' academic development are in the preliminary stage (Woon & Chin, 2018; Yap & Baharudin, 2015). Currently, local studies focused on fathers' support have been limited to their involvement (Yap & Baharudin, 2015), attachment (Yahya et al., 2019), hostility and monitoring (Jafari et al., 2016), parenting styles (Woon & Chin, 2018), and autonomy support (Tan et al., 2021). Excluding Yap and Baharudin's (2015) study that linked fathers' involvement to only academic efficacy, the others have linked fathers' influence to various adolescent outcomes (e.g., life satisfaction, depression, anxiety, and self-esteem). Several other local studies examined fathers' parenting in the special needs context, which made their results not comparable. A review of local studies showed that investigations on fathers' support and learners' academic development were not systematic, and their influence on learners' self-efficacy development not adequately addressed. So far, to the researcher's knowledge, there has been no local attempt linking fathers' support with STEM efficacy. Hence, urgent attention on this is needed.

Despite much of the literature showing parental support as the key to learners' STEM success, it is disorganised, and mostly neglects the father's role (Hoferichter & Raufelder, 2019). For example, some studies preferred to investigate overall parental support. This included examining family support and its relationship with efficacy, interest, and engagement in science learning (Sha et al., 2016), or the influence of parental support on STEM grades (Hoferichter & Raufelder, 2019). Another study found that emotional support from parents cultivated learners' early scientist and STEM-career interests (Buschor et al., 2014).

In contrast, other scholars focused on specifically studying parental support in STEM learning. For example, a qualitative study revealed that parents' physical support in science learning motivated learners' STEM interest, and their decision to enrol in STEM education (Halim et al., 2018). Garriott et al (2014) found that parental support in providing mastery experiences in STEM activities predicted learners' efficacies in math and science. Koch et al (2019) found that parental support in supplying materials, and providing emotional and social support during STEM learning predicted STEM persistence and career choices among urban

American girls. Of these studies, only Hoferichter and Raufelder (2019) separately investigated the fathers' and mothers' roles on learners' STEM grades, and revealed that the fathers had no impact on them. This finding contradicted past literature, which demonstrated that parental support usually benefitted learners' STEM outcomes. Considering that there were other studies indicating the fathers' significant impact on learners' academic growth (e.g., Hwang & Jung, 2020; Lv et al., 2018; Yap & Baharudin, 2015), even in science learning (Bartley & Ingram, 2018; Demirtaş & Uygun-Eryurt, 2020), continuing to reinvestigate their influence on STEM outcomes is necessary.

At present, STEM-related investigations have been largely based in the Western context, particularly American societies (Thomas et al., 2020). As emphasised by Thomas et al (2020), even though parental support in the home has a great influence on learners' STEM learning, this aspect has received little attention. Currently, the literature is limited on differentiating the influence of different social agents, and the forms of their support (e.g., in-school and homed-based support) on learners' STEM learning. In Malaysia, STEM-related investigations have largely been in school settings (e.g., regarding availability of physical materials, laboratories), and school populations (e.g., teachers' STEM competencies, students' STEM grades, etc.) (as reported in Jayarajah et al.'s 2014 meta-analysis), but have neglected the parents' contribution to the success of STEM education. Hence, further attention on this is needed.

Influence of Parental Support on Academic Efficacy

In the present study, fathers' support includes three specific domains: involvement, structure, and autonomy support. Each of these domains has been linked to various adolescent outcomes, including academic development.

Past literature relating to parental involvement has been extensive (Yan et al., 2017), and has proven its benefits on the self-efficacy of adolescents in both Western and cross-cultural studies. However, the concept of involvement support varies across studies. For example, parental involvement in the form of warmth (Graziano et al., 2009), collective support (relatedness, competence, and autonomy support) (Liu et al., 2019), academic involvement (e.g., monitoring homework, communicating with teachers) (Jeynes, 2011), and their sharing of educational aspirations and goals (Lv et al., 2018) were found to predict adolescents' academic efficacy. In the area of science learning, two studies also found that parental involvement benefitted learners' STEM learning, for example, motivation and grades (Otto & Karbach, 2019), and efficacy, engagement, and intrinsic motivation (Fan & William, 2010) in mathematics.

Past literature on the other two domains, structure and autonomy support, is mostly Western literature (Wang et al., 2007; Yan et al., 2017). Structure support has been conceptualised as parents' reasonable demands on adolescents for obedience, control, and maturity (Grolnick, 2016), and was claimed to be a consistent predictor for academic development in many studies. For example, parents' reasonable control (e.g., conveying rules, expecting obedience, consistent implementation, etc.) improved adolescents' academic efficacy (Skinner et al., 2005), and reduced beliefs about maladaptive control in academics (Grolnick & Wellborn, 1988). Conversely, high academic interference (excessive help with decision making, assistance in homework completion, etc.) hindered the development of academic efficacy (Gonda & Cortina, 2014; Padilla-Walker & Nelson, 2012).

In contrast with the previous review, two studies suggested that parental structure support directly predicted academic grades, but not efficacy. Specifically, Grolnick et al.

(2014) found that structure support did not significantly relate to academic efficacy. Likewise, Jungert and Koestner (2015) found that structure support had an insignificant effect on the learners' science efficacy. In fact, findings in cross-cultural contexts were debatable. Lv et al. (2018) claimed that the effect of parental control on learners' academic efficacy depends on the quality of the parent-child attachment. In particular, excessive academic help, triggered by the parents' disappointment with the learners' academic performance, may result in pressure. Therefore, learners may feel reluctant to refer to their parents in building their academic beliefs. Another study in China indicated that only the fathers' control benefitted learners' academic efficacy and grades due to their significant academic roles in Chinese families (Lan et al., 2019).

On the other hand, the literature has indicated autonomy support having a strong link with adolescents' overall internalisation and adaptation process. Autonomous parents who convey mutual understanding, encourage individuation, and provide freedom to adolescents are likely to cultivate quality social interactions, helping adolescents to feel emotionally calm, and more receptive to parental instructions during goal mastery processes (Grolnick et al., 2014). Highly autonomous parents are often found to raise learners with better adaptive abilities, for example, those having higher academic efficacy and/or control (e.g., Gonida & Cortina, 2014; Grolnick et al., 2014; Hwang & Jung, 2020). Similar findings were discovered with cross-cultural samples, where autonomous parents were found to promote positive homework emotions among young adolescents in China (Liu et al., 2019), the academic motivation, grades, and esteem of Asian and American high school learners (Jiang et al., 2011), and the academic grades of Chinese American high school students (Liew et al., 2014). However, these studies did not distinguish between mothers' and fathers' parenting.

Several limited works that detailed gendered parental roles have differing results on the fathers' influence. Two Western studies showed that fathers' autonomy support for older adolescents predicted neither academic efficacy (Hwang & Jung, 2020), nor intrinsic and extrinsic school motivation (Gillet et al., 2012). In contrast, Ravindran et al. (2020) found that fathers' autonomy support significantly predicted the innate need for autonomy of American adolescents, and promoted their competence in conflict discussion tasks. Likewise, Duineveld et al (2017) also found that their support reduced learners' depression, and increased self-esteem in learning.

Ravindran et al (2020) criticised the literature on autonomy support as it has been more concerned with mothers' influence, and highlighted the need to further investigate the fathers' role. As Hwang and Jung (2020) stated, fathers own unique child-rearing beliefs, and their choice of parenting strategies and father-child activities are different from other social agents. In light of this, the autonomy support of fathers and mothers can be different. Ravindran et al (2020) revealed that the fathers' autonomy support tends to encourage children to take risks, and expose them to challenges, but at the same time, restricts offering protection (Paquette, 2004). Adolescents need this freedom to explore and self-realise their potential, hence cultivating their agency thinking and efficacy (Joussemet et al., 2008; Ryan & Deci, 2000). Currently, studies on fathers' autonomy support are limited, and findings are inconclusive in both the Western and non-Western samples. Therefore, this warrants further examination.

Hope as Mediator

Based on Snyder's Hope Theory (2002), hope involves two cognitive processes, namely agency and pathway. Pathway hope refers to a person's belief in their ability to attain their

goals by producing workable routes while agency hope is belief in the likelihood of success in the present and future. High-hope students tend to have higher expectations on their class performance, motivating them to work harder to attain desired goals (Snyder, 2002). They are also more likely to find alternative routes to succeed when encountering difficulties than those with low hope (Snyder et al., 2003). With positive agency thinking (positive self-talk, e.g., "I can do this" and "This is not time to give up"), high-hope learners usually display more perseverance in choice and effort until they succeed.

Many educational studies discussed hope as a salient predictor or mediator for academic variables. The current review showed that hope has been related to various academic variables, for example, school grades (Liew et al., 2014), efficacy (Demirtaş, 2019), academic anxiety (Demirtaş & Uygun-Eryurt, 2020), and academic engagement (Padilla-Walker et al., 2011). To date, most studies on hope use adult samples (Padilla-Walker et al., 2011, Lian & Choo, 2020), leaving its effect on young learners unclear.

Studies on older adolescents have discovered the significant mediating role of hope in the link between parental support and learners' academic outcomes, including between parental support and academic grades (Liew et al., 2014), academic efficacy (Demirtaş, 2019), math anxiety (Demirtaş & Uygun-Eryurt, 2020), and school engagement (Padilla-Walker et al., 2011)2011). However, despite these studies proving the significant mediating effect of hope, it is uncertain whether they are comparable as they had conceptualised parental support differently, and focused on diverse academic factors. Some studies highlighted quality of attachment as a consistent source of hope (e.g., Demirtaş, 2019; Demirtaş & Uygun-Eryurt, 2020; Padilla-Walker et al., 2011). Considering that positive parental involvement, structure, and autonomy support can foster parent-child attachment (Koehn & Kerns, 2017), these forms of parental support may likely predict hope.

To date, literature on the influence of fatherhood, hope, and science-based learning is severely lacking. Therefore, further investigation is needed. In Malaysia, hope studies with adolescents are uncommon (Lian & Choo, 2020). Lian and Choo's (2020) local study made a pioneering attempt to investigate primary school learners' hope, and their academic grades. The findings showed hope to be a significant predictor. As a result, it is worth investigating further if hope is a significant predictive factor for other important academic skills, like STEM efficacy.

Currently, insofar as is known, no other local study has examined fathers' involvement, structure, autonomy support, hope, and STEM efficacy in a single analysis model, which therefore makes this study unique and meaningful. By unfolding more predictors for STEM efficacy, this study hopes to improve local STEM programmes for young learners. To bridge the gap in literature in the areas of fathers' parenting, hope, and efficacy in STEM learning, the following conceptual model (Figure 1) was developed. In particular, this study aimed to test the following hypotheses:

H_{a1-3}: Fathers' involvement/ structure/ autonomy support has a significant direct effect on STEM efficacy

Ha_{a4-5}: Fathers' involvement/ structure/ autonomy support impacts STEM efficacy through hope.

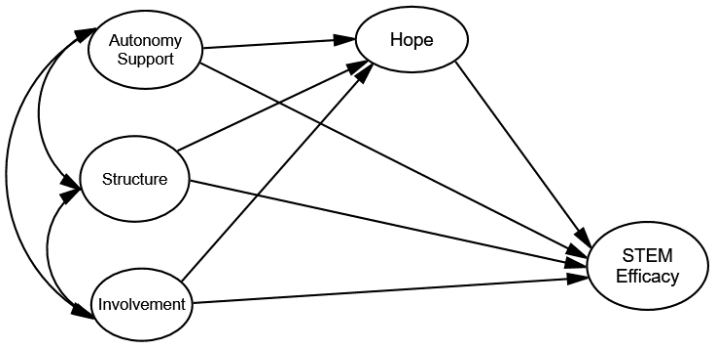

Figure 1
Theoretical Model

Methodology

The present study is a quantitative research that employed a cross-sectional survey and correlational research design. Using random sampling, a total of 548 upper primary school Malaysian students who live within the Klang Valley (or named KL) were selected as samples. The participants were between 9 to 11 years old, and comprised 274 female and 274 male students. In terms of ethnicity, a large majority of the students were Malay (N=387, 71%), followed by Chinese (N=103, 19%), Indian (N=45, 8%), and others (N=13, 2%). This study involved only government and government-aided schools situated within KL: *Sekolah Kebangsaan* (SK), *Sekolah Jenis Kebangsaan Cina* (SJKC), and *Sekolah Jenis Kebangsaan Tamil* (SJKT). The rationale for restricting respondents to only those in urban government primary schools was to ensure that they were in similar living and schooling contexts. 385 students were selected from SK, 138 students from SJK(C), and 25 students from SJK(T). Most of the respondents were from middle-income families, with educated parents (above 80% had completed at least SPM).

Instrument

To measure the key variables, four existing scales were adapted. In total, this study utilised 37 items to measure involvement (6 items), structure (6 items), autonomy support (6 items), hope (5 items), and STEM efficacy (14 items). All items were translated into the Malay language using Brislin's (1986) back-translation technique, and composed on a 5-point Likert scale, ranging from 1=Never to 5=All the time. Fewer measurement items were included as young learners are usually less patient. To ease their understanding, the original items were shortened and simplified. Consent was also obtained from the questionnaire authors before these modifications were made. The following briefly describes the instrument used.

Measurement for Fathers' Support

The present study measured fathers' support in three domains. In particular, 12 items were adapted from Grolnick et al (1991)'s Perception of Parents Scale (POPS –The Child Scale) to measure fathers' involvement, and autonomy support. Fathers' involvement measured how they offer warmth, communication, emotional support, and resources. Autonomy support measured the degree of freedom fathers allowed the adolescents in decision making and offering opinions, and their use of guilt induction. Past evidence revealed that POPS (The Child Scale) was reliable (Wong, 2008). Likewise, the current pilot study (N=304) also reported that the adapted fathers' involvement and autonomy support scales achieved a Cronbach's alpha value of .75 and .74 respectively. From Robinson et al.'s (1996) Parenting Style and Dimension

Questionnaire (PSDQ), 6 items were selected from the "directiveness" domain to reflect parental control. Based on the pilot test, the adapted structure scale reached a .75 reliability level. To calculate, each sub-construct was summed up to generate the sub-scores. The higher the score, the higher the support received from the fathers.

Children's Hope Scale (CHS)

The Children's Hope Scale (CHS) was developed by Snyder et al. (1997) to measure children's positive expectations in two domains: pathway and agency. CHS measured the extent to which children believed they can find ways to deal with obstacles, and their likelihood of success in the future. To calculate, the scores of all items were added up to yield a composite hope score. A high score indicated high hopeful thinking. The CHS was tested reliable (α=0.72 to .86) in Snyder et al.'s (1997) study. In the pilot test, the adapted CHS obtained a reliability of .74.

STEM Efficacy Children Scale (SECS)

The SECS comprised 14 items to measure the perceived self-efficacy of young learners in STEM learning. The scale was developed and validated by Kai-Sze et al. (2022) with Malaysian primary school samples, and was composed using the Malay language. It comprised three STEM domains: Mathematics (5 items), Science (4 items), and Engineering (5 items). The students were asked to rate their answers based on a 5-point Likert scale. Kai-Sze et al (2022) reported the SECS to be reliable, ranging from .83 to .86. For the scoring, each sub-domain was added up to yield sub-scores. Alternatively, the scores of all 14 items were summed up to generate a composite STEM efficacy score. A high score indicated high self-efficacy in STEM learning.

Findings and Discussion

Structural Equation Modelling (SEM) was employed to test the hypotheses on the direct effects of fathers' support (IV) on STEM efficacy/SE (DV), and the mediating effects of hope between the IVs and DV. The analysis model was first validated using the Confirmatory Factor Analysis (CFA) by testing the fit indices, and calculating convergent and discriminant validity. The overall model involved five latent variables: fathers' involvement (IN), structure (ST), autonomy support (AS), hope, and STEM efficacy (SE). Item parcelling technique was used to reduce the items in the model. Eventually, each IN, ST, and AS were measured with 3 item parcels, and hope with 2 item parcels. The final model comprised 25 items in total. Figure 2 presents the overall measurement model.

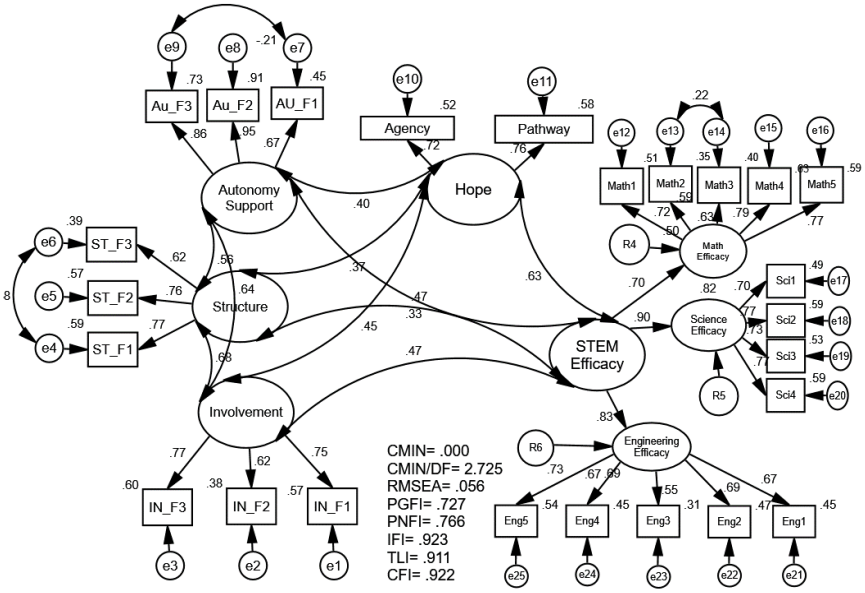

Figure 2
Overall Measurement Model

Confirmatory Factor Analysis (CFA)

Based on the CFA, the goodness-of-fit indices revealed the model to be a good fit. Inspecting the modification indices (MI) of this model, 3 pairs of errors showed MI values greater than 15 (suggested MI threshold value <15 based on Meyer et al., 2017 and Awang, 2015). These included e4 and e6 (ST1 and ST3) from the ST domain, e7 and e9 (FA1 and FA3) from AS domain, and e13 and e14 (Math2 and Math3) from SE domain. These errors were correlated. As a result, the model fit was slightly improved. Finally, the model obtained CMIN/DF=2.725, RMSEA=.056, CFI=.922, IFI=.923, TLI=.911, PGFI=.727, and PNFI=.766.

To determine the convergent validity, and construct reliability of the model, Average Variance Extract (AVE), and Composite Reliability (CR) were calculated using a Microsoft Excel file. The threshold value for AVE is .50 and above, and CR is .70 and above (Hair et al., 2010). The present analysis revealed that all constructs obtained AVE >.50, and CR >.70. This included fathers' IN (AVE=.563, CR=.792), ST (AVE=.578, CR=.804), AS (AVE=.579, CR=.799), hope (AVE=.55, CR=.71), and SE (AVE=.663, CR=.854). Hence, convergent validity was achieved.

Discriminant validity assesses the extent to which a group of theoretically defined constructs is similar or distinct from each other (Hair et al., 2010). Fornell and Larcker (1981); Hair et al (2010) stated that r ≥.90 between two constructs indicate a high correlation, and violated discriminant validity. The present model showed that all constructs were correlated with r values lower than .90, hence proving the model's discriminant validity. Subsequently, the SEM was used for hypothesis testing. Figure 3 illustrates the full structural equation model based on the standard regression weight.

Descriptive Findings for Key Variables

Based on the descriptive analysis of the key variables, the local young adolescents reported that their fathers used more AS (M=3.403, SD=1.103), followed by IN (M=2.897, SD=1.106) and ST (M=2.465, SD=1.050). This finding showed that Malaysian fathers are aware that their adolescents need autonomy support, but at the same time, they provide reasonable guidance and control for their growth. This parental support pattern (higher AS and IN,

combined with lower control) is ideal when parenting adolescents (e.g., Hwang & Jung, 2020; Padilla-Walker et al., 2019).

Compared to several local works, the present result contradicted Hossain (2014), Jafari et al (2016); Woon and Chin (2018), who previously reported that Malaysian fathers are authoritarian parents who use more control and discipline, and are less caring. In contrast, the present analysis showed that KL fathers were moderately autonomous, involved (e.g., warm, resourceful), and less controlling. This finding signifies a shift in the parental norms of urban fathers. In a fully urbanised place like KL, parents are likely to work full-time, and have busy lifestyles. Expectedly, both parents may be involved in child-rearing duties, which leads to the overlapping of parental roles. Moreover, most of these fathers were knowledgeable and educated (at least SPM graduates), and thus, may have better awareness in utilising positive parenting, using more autonomy support and involvement than control with their adolescents. This is supported by the fact that KL has been reported to have the highest literacy rate in Malaysia (Khazanah Research Institute, 2018).

On the other hand, local adolescents perceived themselves as being hopeful (M= 3.638, SD=0.699), indicating that they possessed positive expectations for their present and future. Besides that, they also reported perceiving themselves as "sometimes" having STEM efficacy (SE) (M=3.090, SD=.074). Among the three sub-domains of SE, learners reported having highest efficacy in handling mathematics (M=3.193, SD=.845), followed by science (M=3.105, SD=.948), and the least in engineering (M=2.975, SD=.895). This result was in line with past studies that reported local learners being weak in science subjects, and STEM application during the international assessment of TIMSS and PISA (as mentioned in Martin et al., 2012; MOE, 2013; Mohtar et al., 2019). However, these studies involved adolescent samples of either mixed ages or older, but not young learners (Jayarajah et al., 2014). This present finding has helped to unfold that the STEM efficacy of local young learners may also be at risk, and suggests a call for further review or improvement of the STEM programmes in local primary schools. Table 1 below summarises the descriptive statistics for fathers' IN, ST, AS, hope, and SE.

Table 1
Descriptive Statistics for Fathers' IN, ST, AS, Hope, and SE

Key Variable	**Sub-Construct**	**M**	**SD**
Fathers' Support	IN	2.897	1.106
	ST	2.465	1.050
	AS	3.403	1.103
Hope	Hope	3.638	0.699
STEM Efficacy	SE (Overall)	3.090	0.747
	Math	3.193	0.845
	Science	3.105	0.948
	Engineering	2.975	0.895

Evaluation of the Structural Equation Model

A regression analysis was carried out. This section first discusses the direct effects of all predictive constructs (IN, ST, AS, and Hope) on SE, followed by the mediating role of hope. Figure 3 illustrates the full structural model with all the regression paths.

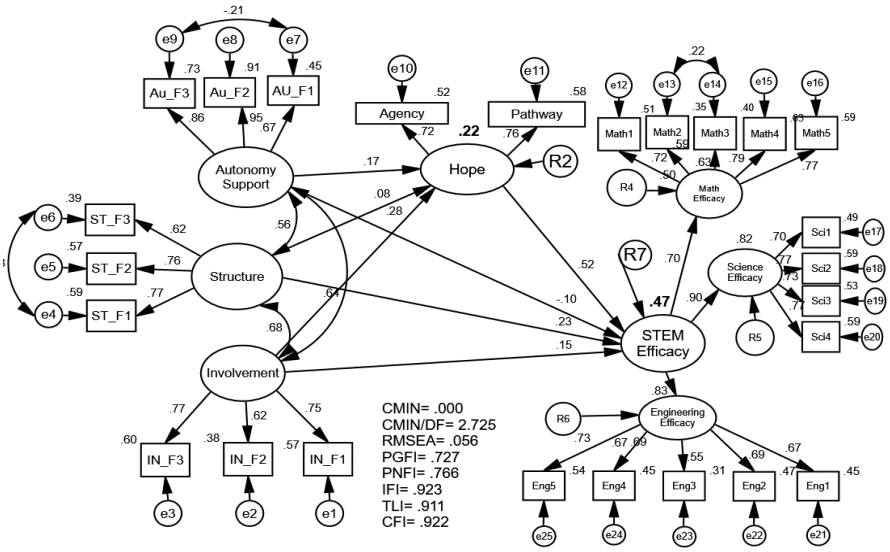

Figure 3
Standardised Regression Weights for Every Path in Model

The simplified equation obtained is presented in Figure 4 to illustrate the paths in both the direct and mediated models. Among all the predictive constructs, fathers' IN (β=.275, p=.002), ST (β=.284, p=.001), and Hope (β=.515, p=.001) showed significant direct effects on SE, but not for AS (β=-.002, p=.976). The fathers' IN and ST had small effects on SE while hope predicted SE to a large degree.

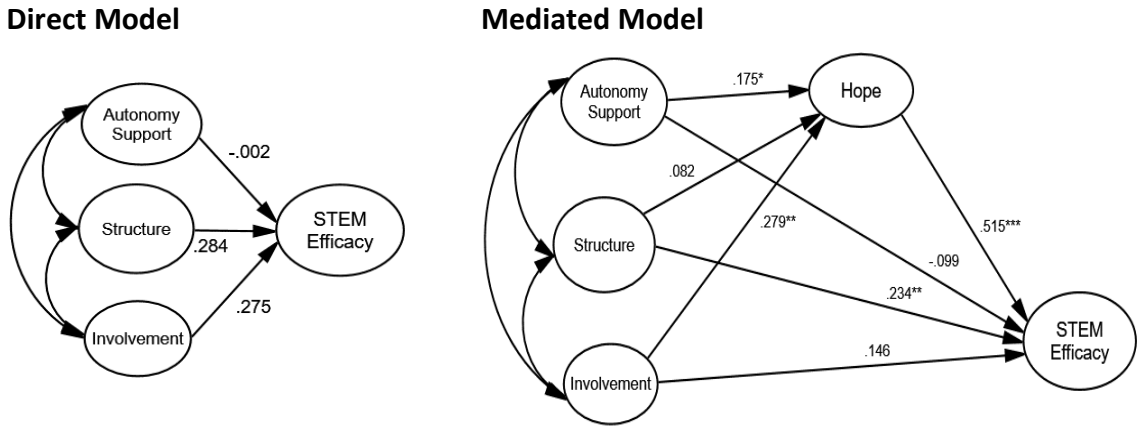

Figure 4
Direct and Mediation Path Analysis: Fathers' Support, Hope, STEM Efficacy

In the mediation analysis, hope fully mediated the relationship between IN and SE. In the original model, IN significantly predicted SE (β=.275, p=.002). After the inclusion of hope (mediator), the direct effect of IN on SE became insignificant (β=.146, p=.093). The indirect paths of IN to Hope (β=.279, p=.004), and Hope to SE (β=.515, p=.001) were statistically significant. Hence, full mediation occurred.

Likewise, hope mediated the relationship between AS and SE. Originally, AS did not significantly predict SE. In the mediation model, all indirect paths: AS to Hope (β=.175, p=.014), and Hope to SE (β=.515, p=.001) were statistically significant. However, the path

from AS to SE remained insignificant. In this case, this is 'just indirect effect' mediation. In other words, fathers' AS significantly impacts SE only when learners feel hopeful.

In contrast, hope did not mediate the effect of ST on SE. The path from ST to hope was insignificant (β=.082, p=.330). ST remained a unique positive predictor for SE (β=.234, p=.002). Table 2 summarises the paths of the constructs based on the direct and mediated models.

Table 2
Direct and Indirect Paths Based on Direct and Mediated Models.

Model and Paths			B	β	S.E.	C.R.	P
Direct Model							
SE	<---	AS	-.001	-.002	.026	-.030	.976
SE	<---	ST	.156	.284	.046	3.372	.001
SE	<---	IN	.151	.275	.049	3.103	.002
Mediated Model							
Hope	<---	AS	.191	.175	.077	2.464	.014
Hope	<---	ST	.108	.082	.111	.974	.330
Hope	<---	IN	.344	.279	.121	2.851	.004
SE	<---	AS	-.048	-.099	.030	-1.601	.109
SE	<---	ST	.136	.234	.044	3.072	.002
SE	<---	IN	.079	.146	.047	1.681	.093
STEM	<---	Hope	.228	.515	.033	6.978	.001

The two significant mediation analyses were confirmed with a bootstrapping test conducted via 5000 samples at a 95% confidence interval (CI). Based on Mallinckrodt et al. (2006), a significant mediating effect occurred as the statistically significant CIs were not zero. The bootstrapping findings showed that there were significant indirect effects on the relationships from IN to SE (CI=[.274,.045], p=.005), and from AS to SE (CI=[.057,.018], p=.017). Hence, the mediating effects of hope were confirmed. Table 3 presents the summary of the bootstrapping tests.

Table 3
Summary of Bootstrapping Test

Paths	SIE	SIE (*p*)	Std. Direct Effect (*p*)	CI LB	CI UP	Type of Mediation	Decision
IN-Hope-SE	.150	.005	.129	.045,	.274	Full Mediation	Supported
AS-Hope-SE	.093	.017	.180	.018,	.057	Indirect Effect	Supported

Discussion

The present finding is important to show that the fathers' structure (ST) and involvement (IN) support are unique predictors for the STEM efficacy (SE) of young adolescents in a collectivist context. Overall, the finding was in line with past literature. The significant path of ST on SE is explained here. Fathers' parenting has often been described as more instructional and goal-oriented (Jeynes, 2016; Kim & Hill, 2015). Therefore, father-child interactions are likely to be domain-specific. In the educational context, some common forms

of parental structure are setting rules and limits, giving direct academic guidance, sharing academic aspirations, and providing constructive feedback for adolescents (Lan et al., 2019). This form of support provides a systematic framework for learners to better imagine what needs to be done, and teaches them that their choices and actions could lead to certain outcomes (Grolnick et al., 2014), and consequently, leads them to have better control over their academic development.

Based on this Malaysian sample, among all the factors, the fathers' ST was the strongest predictor for SE. Unlike several Western works (e.g., Graziano et al., 2009; Hwang & Jung, 2020), or even cross-cultural studies (Lv et al., 2018, Yap & Baharudin, 2015; Woon & Chin, 2018), which suggested that the effect fathers had was small, Malaysian fathers' ST showed a greater predictive effect on SE (almost reaching medium degree). This may be due to two reasons. First, this study focused on examining an academic variable (SE). As fathers' parenting is more goal-oriented (Suizzo et al., 2017), their ST may be more concerned in assisting academic learning (e.g., science, and maths) rather than overall supervision and monitoring. Hence, it had more influence on academic outcomes. Besides that, STEM learning may involve specific guidance in tasks (e.g., logical and problem-solving skills, operation of science procedures, etc.). Urban fathers, who are more highly educated, may have a better grasp of science, and can therefore better guide their adolescents. Hence, fathers' ST has a unique influence on SE development.

However, Malaysian fathers' IN had a larger predictive effect on SE compared to past studies (e.g., Graziano et al., 2009; Liu et al., 2019; Otto & Karbach, 2019). Due to the unique parental context of fathers, though the present study examined fathers' overall involvement, adolescents may still relate their fathers' IN to the development of their academic skills. In light of Attachment Theory, KL fathers who used positive parental support (used more AS and IN, but less ST) may likely encourage pleasing interactions with their adolescents (Hwang & Jung, 2020). These enjoyable social experiences then help adolescents to be more receptive to their fathers' words (Padilla-Walker & Nelson, 2012), which benefit their SE development.

Surprisingly, the fathers' AS did not significantly predict SE. This finding contradicts several Western works (e.g., Gonida & Cortina, 2014; Grolnick et al., 2014), and even some cross-cultural studies (e.g., Jiang et al., 2011; Liew et al, 2014; Liu et al., 2019) which found that autonomous parents cultivate learners' academic control and other related skills. This could be due to the cultural factor. Collectivist cultures value hierarchy in the family, and therefore, parents making the decisions for their children is culturally accepted (Lan et al., 2011). Asian children are taught to be obedient from a very young age (Jiang et al., 2011), and their tolerance of parental control is higher (both physical and psychological aspects). Therefore, despite Malaysian adolescents' perceiving that their fathers give them autonomy, they may not see it as particularly important for their academic development. However, as many cross-cultural studies have proven the significant impact of parents' AS on learners' academic advancement, further investigations are recommended.

Fathers' AS that often exposes children to risk-taking and exploring new challenges (Paquette, 2004) is likely to cultivate learners' efficacy (Joussemet et al., 2008). However, this description of fathers' AS is mainly derived from Western contexts (Yan et al., 2017); it is uncertain if it would be similar with collectivist fathers. Besides that, in light of gendered parental studies, the child-rearing beliefs and parenting strategies of fathers differ from mothers (Hwang and Jung, 2020). Hence, other AS studies that explored the perceptions of mothers may not be reliably comparable. As culture can affect fathers' parental norms, further investigation on fathers' AS in a collectivist context is needed.

In line with theoretical and literary evidence, hope was found to be a powerful predictor for SE (e.g., Atik & Atik, 2017; Bryce et al., 2019). This is supported by Hope Theory, which discusses that learners with high hope are often motivated to try multiple solutions to succeed, and are better regulated behaviourally and emotionally, and therefore, develop positive academic functioning (Snyder, 2002). Besides that, some scholars explain that, because hope and efficacy are positive expectations, both function similarly as a person's internal motivational mechanisms (Jiang et al., 2013; Tomás et al., 2018). Hence, hope and efficacy are likely to show a strong correlation. As adolescents become more independent and autonomous (Grolnick et al., 1991), their inner beliefs like hope may eventually become a strong factor in their self-motivation to pursue academic goals, hence, helping to predict their STEM-related skills.

The Mediating Effect of Hope

The relationship between fathers' support and hope was supported by Snyder's (2002) Hope Theory, which determined that positive interactions with parents were the main source of hope. Past literature (e.g., Gungor, 2019; Yarcheski & Mahon, 2016) suggested that social support has a moderate to large influence on hope. However, the present result showed that fathers' influence on hope was small. This may be due to variations in how social support was defined. While much of the literature on hope was concerned by the influence of collective social support on hope (e.g., Archer et al., 2019; Chen et al., 2021; Demirtaş, 2019), the present finding demonstrated the unique influence of fathers on hope in a collectivist culture.

In particular, Malaysian fathers' IN and AS predicted hope, but not ST. This is because ST support involves more direct physical guidance (e.g., providing supervision or guidelines for homework, etc.), which is more likely to be specifically linked to academic control or grades (Gonda & Cortina, 2014; Skinner et al., 2005), but not general beliefs like hope (Tomás et al., 2018). Besides that, a lot of the literature has highlighted the quality of the parent-child bond as the overriding factor that determines the development of hope (Demirtaş, 2019; Feldman et al., 2016; Gungor, 2019). As Malaysian culture is academically oriented, parents may have higher academic expectations when assisting learners. Consequently, the fathers' ST support may entail academic pressure, which makes their interactions less pleasing, and hence, do not build hopeful beliefs.

Parents' IN and AS in favour of the value internalisations of adolescents, and their psychological well-being have been extensively discussed (e.g., Cooke et al., 2019; Demirtaş, 2019). In fostering hopeful thinking, Snyder (2002) said that hopeful words from trusted social agents play a main role. Currently, fathers' IN was a stronger predictor for hope than AS. This is probably because IN support for the adolescents requires fathers to express their warmth, affection, and emotional support through verbal communication. Hence, this creates many opportunities to engage learners in hopeful communication (e.g., through sharing about the future and aspirations, reducing academic and future stress, etc.). Thus, fathers' IN is a more powerful predictor of hope.

In the present study, the significant path from AS to SE can be uniquely explained by the fathers. Fathers are usually less protective, and allow greater freedom for their children to take risks (Paquette, 2004; Ravindran et al., 2020). This context is similar to STEM tasks that require learners to self-explore, be creative in problem solving, and innovative. Therefore, such "training" by the fathers is more useful for learners as they can transfer these skills to overcoming STEM challenges. This, in turn, helps learners feel hopeful as they believe, with their fathers' support, they are likely to overcome difficult tasks. The smaller effect of AS

(compared to IN) on hope may be due to the influence of age. Primary school learners are less mature, and are dependent on their parents for guidance and resources. Hence, their demand for autonomy in building inner motivational beliefs has yet to develop.

The mediation analysis showed that the influences of IN on SE, and ST on SE were solely through hope. This is because IN helped learners to build a strong mind (e.g., foster emotional calmness through providing them care, or reducing stress, etc.), and AS helped strengthen life skills (e.g., dealing with problems practically, experiencing failure and learning from it, etc.), which contributed to building learners' overall beliefs about the future (pathway and agency thinking). Interestingly, the mediation analysis revealed that the influence of AS on SE happens only if hope is present (indirect effect mediation). This is probably because STEM learning may demand practical guidance for procedures and understanding concepts. However, AS may not provide such direct information on these aspects. This is because fathers' AS "training" usually emphasises independence, whereby learners are required to self-explore and self-realise during the goal mastery process, and this may not be specifically related to academics. Therefore, AS was not directly linked to SE. On the other hand, since fathers' IN and ST support often involves direct guidance on STEM learning, these two constructs showed direct significant links to SE.

Lastly, local studies on STEM have revealed that learners have negative attitudes towards STEM learning. For example, learners perceived science subjects as difficult and challenging (MOE, 2013; Mohtar et al., 2019), and felt reluctant to pursue STEM courses (MOSTI, 2008). Such hesitation may be due to low awareness of the importance of STEM for their future success (Falco & Summers, 2019). As fathers' parenting is likely to prepare children for success (Jeynes, 2016; Kim & Hill, 2015), it is worth investigating the extent to which their support can assist learners in gaining better STEM competencies in school.

Conclusion and Implications

The present findings provided implications for STEM educational planning at the local primary schools by suggesting that, for the cultivation of SE, fathers' support in the form of IN, ST, and AS needs to be improved. ST was the strongest factor that predicted SE, which indicated that young learners need more direct guidance in building their SE. Besides that, the finding has expanded the literature on hope with the population of young learners. In a collectivist context, hope functioned as a salient predictor for SE, and was a positive mediator between fathers' support and SE. These findings are unique as insofar, no past study has combined these paths in a single analysis. Moreover, the planning of future STEM programmes needs to consider learners' inner motivational variables like hope because enhancing their hopeful thinking can connect more parental variables (like IN and AS) to SE. Hence, schools may need to find ways to guide fathers to know more about the STEM education in schools, and its learning goals and content so that fathers can provide constructive support (verbally or physically) in the learning outside of the school. To do this, the school may need to communicate with fathers, and educate them on using proper support techniques with their young adolescents. Besides that, in the urban context, the SE of local primary school learners was found to be at risk of declining. This finding calls for further investigation and urges immediate support in STEM learning for young learners. However, since the present study was limited to a fully urban context, focusing on learners aged 9 to 11 years, the generalisability of the findings is restricted. Thus, to broaden this scope, future studies may consider other regions with differing degrees of urbanisation, and learners of a wider age range.

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