



# Relationship between Pre-Schoolers' self-regulation, language, and early academic skills: The mediating role of self-regulation and moderating role of gender

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## Abstract

In early childhood, the development of children's self-regulation, language, vocabulary, and early academic skills is relatively fast. Identifying relationships in the development process is important for discovering various developmental processes. The study aimed to investigate the relationship between self-regulation, language, and early academic skills in children aged 60–72 months. In addition, the mediating role of self-regulation and the moderating role of gender in this context were also examined. The study was made with the participation of 363 children and 20 preschool teachers. A personal information form and children's self-regulation skills form based on the teachers' observations were used to collect data. In addition, the Kaufman Survey of Early Academic and Language Skills (K-SEALS) was administered to the children by the researchers. Validity and reliability tests of the data collection tools showed them to be valid and reliable. The study proposed models and hypotheses according to the theoretical framework and related research. The validity of the proposed model was examined according to fit index values. The significance of the model's hypotheses was determined by path analysis. At the end of the study, the hypotheses tested in line with the proposed model were discussed in light of the literature.

**Keywords** Self-regulation · Receptive language · Expressive language · Early academic skills · Preschoolers

## Introduction

Self-regulation, which is among the most important characteristics that distinguish individuals from other living things, is one of the most important skills that an individual should have in the information age since it has an impact on the social and academic competencies of the person throughout his life. The self-regulation skill, which begins to develop with birth, develops significantly during early childhood, being affected by environmental factors such as home environment, nonparental care settings, peer group, neighborhoods, and culture (McCabe et al., 2004). This skill continues to change and

develop as it is affected by various factors in adolescence and young adulthood (Murray & Rosanbalm, 2017). Self-regulation, the development of which is supported mainly in the early years, leaves its mark in adult life. (Duckworth & Seligman, 2005). It has been found that adults with high levels of self-regulation are successful in their work and social lives (Tangney et al., 2004). Since early childhood is a period in which self-regulation develops rapidly and self-regulation in later childhood will affect other developmental areas, it is important to evaluate and support self-regulation skills in early childhood (Montroy, Bowles, Skibbe, McClelland, & Morrison, 2016a).

Language skills are among the critical skills that develop rapidly in the preschool period such as the self-regulation skill. Preschool children use their language skills effectively to influence others and regulate their behavior. While children are controlled externally in the first year of the preschool period, intrinsic control increases in children in the following years of the preschool period. Preschool children exercise their own control in using their language and self-regulation skills. However, environment continues to play a critical role in the development of language and self-regulation skills in preschool children (Murray & Rosanbalm, 2017). Supporting

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the language (Dickinson & Tabors, 2001) and self-regulation skills of children in preschool and beyond is critical for success in both social and academic life (Best & Miller, 2010). When the relationships between self-regulation, language, and early academic skills were examined, it was seen that a relationship between language skills and self-regulation skills had previously been reported (Ayoub et al., 2011; Bohlmann et al., 2015; Petersen et al., 2013; Petersen et al., 2015; Pisoni et al., 2008; Roben et al., 2013; Vallotton & Ayoub, 2011). Both language and self-regulation skills are also related to early academic skills. Many studies of early childhood self-regulation skills examine early academic skills such as mathematics and literacy (Denham et al., 2012; Nayfeld et al., 2013; Suchodoletz et al., 2013; Blair & Raver, 2015). Language skills have also been found to be associated with early academic skills (Abedi & Lord, 2001; Blair & Razza, 2007; Bull et al., 2008; Denham et al., 2012; Espy et al., 2004; McClelland et al., 2007; Nayfeld et al., 2013; Ponitz et al., 2009; Purpura & Reid, 2016; Taşkın & Tuğrul, 2014).

In light of the relevant literature, language (Abedi & Lord, 2001; Purpura & Reid, 2016; Taşkın & Tuğrul, 2014) and self-regulation skills (Blair & Raver, 2015; McClelland et al., 2013; McClelland et al., 2014) could positively affect academic skills. According to Vygotsky (1962), the self-regulation skill is directly and positively affected by the language skill. In this context, the self-regulation skill can act as a mediator between language and early academic skills. In this study, whether self-regulation plays a mediating role between language and early academic skills will be examined in light of the proposed model.

In addition, the review of the literature revealed that gender is considered to be a variable that affects language skills and self-regulation skills in preschool children (Matthews et al., 2009; Guimard et al., 2012; Suchodoletz et al., 2013; Vallotton & Ayoub, 2011, Størksen et al., 2015; Montroy, Bowles, & Skibbe, 2016b; Fung et al., 2019). Research has shown that girls have better language skill performance than boys (Barbu et al., 2015; Eriksson et al., 2012). The self-regulation skill variable was found to differ significantly according to gender in favor of girls based on the results of research conducted in the United States (Fung et al., 2019; Montroy, Bowles, Skibbe, McClelland, & Morrison, 2016a). Meanwhile, Icelandic girls outperformed boys significantly in behavioral self-regulation (Gestsdottir et al., 2014). Similarly, for the origins of the United States such as Hispanic, Asian, American Indian, Eskimo, and other minorities, self-regulation differed according to the gender variable (Holmes et al., 2016).

Although many studies have examined the relationships between language skills, self-regulation, and early academic skills, there are three important reasons for the researchers to conduct this study. The first is that respondents in studies that examine the relationship between language skills, self-

regulation, and early academic skills often speak English (Hanno & Surrain, 2019). However, language is an advanced mental tool that emerges as a result of its interaction with the environment (Vygotsky, 1962, 1978). This being so, the environment in which language emerges is an element of a particular culture. In this context, the relationship between language skills, self-regulation, and early academic skills in Turkish-speaking children should be evaluated in terms of the literature. The theory that maintains that language is an advanced mental tool as an element of culture is Vygotsky's sociocultural theory. In this context, the second reason for conducting the study is to investigate whether language affects early academic skills as a tool of self-regulation if language, self-regulation, and early academic skills are taken in light of Vygotsky's sociocultural theory. Therefore, the self-regulation skill will also be evaluated in terms of Vygotsky's social-cultural theory. The third reason why the researchers have planned this study is that gender has been reported to have an effect on the development of language, self-regulation, and early academic skills in the studies on behavioral self-regulation tasks and academic achievement carried out by Becker, McClelland, et al. (2014b), Schmitt et al. (2014), and Tominey and McClelland (2013) in the USA; and by Baptista et al. (2016), Gestsdottir et al. (2014), and Suchodoletz et al. (2013) in Germany, France, Portugal, etc. Moreover, the researchers intended to contribute greatly to the literature in terms of determining whether gender has a moderating effect on the relationship between language, self-regulation, and early academic skills in Turkish preschoolers.

Accordingly, a model was proposed according to the hypotheses created in light of research on Vygotsky's sociocultural development theory, self-regulation, and early academic skills to reveal the relationship between children's language skills, self-regulation, and early academic skills. While the hypotheses existing in the literature are tested on Turkish children in this proposed research model, it is also expected that reporting whether self-regulation is the mediator variable and whether gender has a moderating effect will contribute to the literature.

The paradigm of this study is the model proposal that enables the mediating role of the self-regulation skill and the moderating role of gender to be examined in the context of the effect of language skills on academic skills. To explain this paradigm, the relationship between self-regulation, language, and academic skills has been analyzed using scientific methodology with hypotheses created in light of the literature. Acting on this, self-regulation, Vygotsky's sociocultural cognitive theory, language skills, and early academic skills are explained under the title of Literature Review. In line with the theoretical information obtained from the literature review and related research results, a model was proposed under the title of Model and Hypotheses.

## Literature Review

### Self-Regulation

Theories intending to explain self-regulation in early childhood have tried to clarify how self-regulation develops and the mechanisms that affect self-regulation. In this sense, when the theories are briefly reviewed, behavioral theory, psychoanalytic theory, social learning theory, Piaget's cognitive development theory, Vygotsky's sociocultural development theory, and information processing theory stand out.

According to Freud, one of the founders of psychoanalytic theory, self-regulation is the developing source of the ego in the process of successfully struggling to cope with the challenges faced by the human personality. The ego argues that the development of self-regulation will be supported if the innate impulse of the individual is successful in controlling his/her own behavior and emotions. In his theory, Freud saw self-regulation as emotion regulation and considered the development of self-regulation to be an emotional requirement (Baumeister, 2014; Gailliot et al., 2010).

Behavioral theorists consider self-regulation as learned self-control. The development of self-control will take shape according to the active reward and punishment mechanism they learn from the environment. Children learn to wait for reinforcers to develop self-regulation and to control their negative behaviors to avoid punishment (Bronson, 2000).

Albert Bandura, one of the Social Learning theorists, explains self-regulation with the concept of internalized performance. Internalized performances can be formed by observing the individual's own life and the behavior of others. However, self-regulation depends on whether the standards set are met or not. Self-regulation effectively emerges as a result of the harmony of perceived self-efficacy and the actual self-efficacy of an individual's performance standard (Bandura, 1991).

The self-regulation skill is explained by the concept of balancing in Piaget's cognitive development theory. Children absorb their current knowledge as a result of adapting it to new situations. As the child learns new information, the change in his mental schema is the process of adaptation. The imbalance that occurs between assimilation and adaptation makes the child's behavior more controlled and efficient. Thus, it advocates that self-regulation skills develop depending on the child's cognitive development and the level of better adaptation to the difficulties they encounter in the environment (Fox & Riconscente, 2008).

According to Vygotsky's sociocultural development theory, social and cultural factors are important in the development of thinking and self-regulation skills. Vygotsky draws attention to the interaction between the child's thinking and self-regulation and his adult or experienced peers. He argues that language, the symbolic tool of culture in children's interaction with their environment, affects thinking. In addition, language

as a specialized mental tool is the most important tool that supports the development of self-regulation. The child's formation of inner speech is actually the formation of thinking. The child improves his self-regulation skill by learning to give instructions on his own by speaking internally (Bodrova & Leong, 2019).

Information processing theorists have explained how the brain works using the computer model. When explaining thinking, modeling based on the interaction of cognitive elements with processes such as attention, perception, and memory was made. Self-regulation skills are innate programs that include executive functions such as attention, perception, and memory, which are cognitive elements that people use to control their behaviors and thoughts (Bodrova & Leong, 2019; Bronson, 2000).

In light of all these theories, the common point emphasized in the definitions of self-regulation is that it plays an active role in children's learning processes in behavioral, cognitive, emotional, and motivational terms. The concept of self-regulation is explained with concepts such as the ability to delay or suppress the emerging behaviors, will, tendencies, and desires of the individual, as well as self-flexibility and the ability to comply with social norms, control and regulate their emotions, focus on the stimulus for the purpose, and maintain their attention (Posner & Rothbart, 2009; Bauer & Baumeister, 2011; Koole et al., 2011).

Research has shown that one or more theoretical perspectives can be used to support the development of self-regulation skills in children. Considering the definition of self-regulation skill or its relationship with a specific development area, it should be examined in light of relevant theories. In this study, different theories and research results are evaluated as a whole. However, Vygotsky's sociocultural development theory was adopted when discussing how supporting children's language skills, which are seen as a specialized mental tool of a particular culture, affects the self-regulation skill. Vygotsky sees language skills as an important symbolic tool of culture in his theory. In this case, the language of the children participating in this study is Turkish. In this context, a question arises in the study. How does supporting children's language development in early childhood affect their self-regulation skills? If we answer this question according to Vygotsky's (1962) cognitive development theory, which refers to the importance of the environment in the development of self-regulation, Vygotsky emphasizes the importance of self-talk, internalized in early childhood, in terms of self-regulation. Vygotsky thinks that the ability to use internalized language to identify internal states and external conditions is the basis of all forms of self-regulation. This issue was reported by relevant studies (Braak et al., 2019; Gandolfi & Viterbori, 2020; Kuhn et al., 2016; White et al., 2017). It is understood that the research carried out so far mainly studied English-speaking children. When we consider language development biologically, the

relevant research results may be similar in terms of Turkish-speaking children, but according to Vygotsky's sociocultural development theory, language is the specialized mental tool of a particular culture. From this point of view, how do the language skills of Turkish-speaking children affect their self-regulation skills? The answer to this question will be tested according to the hypotheses of the study and will be discussed by comparing it with the results of studies on the languages of different cultures. In this context, it is thought that research with Turkish-speaking children will contribute positively to the sociocultural development theory. For the theoretical background of the hypothesis and discussion of the study, the relationship between Vygotsky's sociocultural development theory and self-regulation is explained in detail below.

### Vygotsky, Sociocultural Development Theory and Self-Regulation

Although the theories about self-regulation have different views, the theory that posits that language skills form the basis of self-regulation development is Vygotsky's (1978) sociocultural development theory. In this context, Vygotsky expresses self-regulation as a critical development that marks the emergence of "higher mental functions" based on his general ideas about the cultural-historical nature of human development (Bodrova, 2006). In his theory, which examines self-regulation as a cognitive skill, Vygotsky touches on advanced mental functions expressed in terms of perception, focused attention, conscious memory, and logical thinking (Bodrova & Leong, 2019). Self-regulation is the ability of children to manage their behavior in a conscious and planned way. Up to the age of three or four, children's behavior is reactive, so Vygotsky calls this situation "slaves to the environment." After the age of three or four and in the preschool period, there is a change in the relationship between the intention of the child and the implementation of a subsequent action, and the child can act in a planned way by suppressing his reaction. Thus, the child becomes a "master of his own behavior." Gaining control over their physical, emotional, and cognitive behavior requires the children to master certain cultural tools such as language and other symbolic systems (Bodrova & Leong, 2019). Vygotsky emphasizes that self-regulation is linked to language development, making important points that explain the effect of language and thought on self-regulation. According to Vygotsky, the development of the individual's consciousness occurs primarily through the development of collective (social activity, culture) consciousness and then individual consciousness. This process, which begins with social speech, continues with self-directed speech and inner speech, and in the following process, "verbal thinking" emerges (Vygotsky, 1978). Therefore, the attainment of self-regulation depends on alternative social contexts provided by the family, teacher, and peer group (Bodrova, 2006).

When we examine the development of self-regulation in children according to the relationship between language and self-regulation skills, Bodrova and Leong (2019) emphasize that the acquisition of self-regulation depends on three phases: "the use of self-directed speech", "dealing with others' regulation" and "generalization of rules." Depending on the child's developmental age, these three processes are as follows:

*The use of self-directed speech* peaks at the age of three or four. Self-directed speech acts as a tool for children to develop self-regulation. Self-directed speech is an external tool for self-regulation. It is not intended for communication with others but allows the child to remind himself about his behavior and to direct himself. With self-directed speech, the words that adults use to regulate children's behavior can now be adopted by children to direct their own behavior. With the advancement of age and the internalization of external agents, self-directed speech can be separated from social speech and becomes mental as if there is an internal listener (Berk, 1992; Vygotsky, 1962). Children participate in "regulating others" activities long before they can regulate their own behavior. In this process, children apply the rules to others before applying them to themselves and realize early on that other people break the rules even though they seem unaware that they are breaking the same rules themselves. When regulation is performed by a skilled person such as a parent or teacher, it equips the child with particular "mental tools" that tend to be self-regulated. At the age of about six or seven, children reach a level where they can form generalized rules based on experience that form the basis of self-regulation. As a result, according to Vygotsky, in the development of self-regulation, the behaviors of the child are primarily regulated by external speech. Secondly, the child regulates someone else's behavior with external speech and his own behaviors with egocentric speech. In the last stage, the child regulates his own behaviors through inner speech. A child with advanced self-regulation can first think and then do deliberate and planned behavior (Bodrova & Leong, 2019).

Vygotsky explained this by emphasizing the cognitive aspect of self-regulation in his theory. Those who see self-regulation in terms of sociocultural development theory argue that socioemotional self-regulation and cognitive self-regulation interact with each other (Bodrova & Leong, 2019; Bronson, 2000).

Attention regulation, which is one of the effective and critical components of self-regulation, is defined as the ability to focus, deal with relevant information, and work on a project (Rothbart & Posner, 2005). According to Vygotsky's theory, interactions in the social life of the individual come to the fore in the deliberate evolution of attention processes (Bronson, 2000).

Working memory is the ability to store and process information for a short time. It is responsible for keeping



information and for the conversion process when necessary. It allows children to remember and follow the instructions and helps them plan solutions for a problem (Baddeley, 2012).

Inhibitory control involves monitoring and controlling action and thought (Posner & Rothbart, 2000). Accordingly, it is expressed as an emotional regulation in which the individual is aware of his emotions, managing and inhibiting emotions in excited or stressful situations, or continuing his emotional arousal to achieve the goals (Carlson & Wang, 2007).

Self-regulation discussed in this study consists of components of executive functions that affect each other, such as attention, working memory, and inhibitory control (McClelland & Cameron, 2012).

In a study conducted by Gözüm (2020) on preschool children, working memory and attention were seen to affect inhibitory control. According to Vygotsky, a child with developed self-regulation skills will reflect on the situation to demonstrate appropriate behavior and will, therefore, not consciously perform inappropriate behavior by exercising inhibitory control (Bodrova & Leong, 2019).

The relationship between language and self-regulation skills has been explained in light of Vygotsky's theory of sociocultural development. Receptive language and expressive language skills used in this model proposal were treated according to this theoretical perspective. The concepts of receptive language and expressive language are explained under the title of Language Skills.

## Language Skills

Language skills in the preschool period include the ability to understand verbal language, to express oneself in words, and to understand social communication and practices, whether spoken or written. Listening and reading constitute receptive language skills but speaking and writing, on the other hand, constitute expressive language skills (Gordon & Browne, 2011). Receptive language skills include understanding and interpreting sounds, abstract and concrete words, and grammar rules, applying what they perceive, matching, and synthesizing them. Expressive language skill is defined as the ability to produce various sounds, to create words and sentences by combining sounds, and to convey wishes, feelings, or thoughts to other individuals through language by using the correct grammatical language patterns (Ezell & Justice, 2005; Levey, 2011). The development of listening and speaking skills forms the foundations of literacy skills (Jackman, 2012). According to the National Association for the Education of Young Children (2001), listening, speaking, reading, and writing skills develop as a whole. Although expressive language skills are not developed when the child is born, receptive language skills are developed. Children who store the sounds they receive from the environment in their

memory with receptive language skills will later express these sounds with the development of their expressive language.

Concepts are one of the most basic parts of the mind and are accepted as an indicator of cognitive development (Gander & Gardiner, 2007). The concept repertoire that develops gradually during early childhood is an important tool for the development of logical thinking and reasoning skills (Sucuoğlu et al., 2008). Therefore, basic concept acquisition has a strong connection to language development, intelligence, school readiness, the development of academic skills, and academic achievement (Bracken & Crawford, 2010). Larney (2002) concluded that early language delay is a key risk factor for later literacy difficulties. Crain-Thoreson and Dale (1992), on the other hand, concluded that the frequency of story reading with parents contributes to the improvement of verbal literacy. Accordingly, the vocabulary acquisition of children who develop expressive language skills also improves. The child continues his language development by thinking about newly learned concepts using the recipient language.

According to the theoretical knowledge and research results, there is a mutual relationship between receptive language and expressive language, and this relationship leads to language development. Supporting language skills affects early academic skills. In this study, the effect of receptive and expressive language skills on early academic skills is investigated. Therefore, the early academic skills examined in this study are explained below.

## Early Academic Skills

Early academic skills include basic literacy skills such as vocabulary, phonological awareness, alphabet knowledge, and skills relating to numbers (Duncan et al., 2007). The ability of children to identify the names or actions of objects or to point to or name objects based on verbal descriptions of the properties of objects or actions is what constitutes “*vocabulary*” (Taylor et al., 2010). Phonological awareness encompasses many skills that work together, such as hearing, recognizing, and using separate sounds to enable the individual to notice distinct sounds in language. Alphabet knowledge consists of the written letters of the alphabet and the ability of children to identify these letters. Alphabet knowledge reveals the systematic relationship between letters and sounds (Beauchat et al., 2010). The number skill, which forms the basis of many mathematical concepts, includes skills relating to rhythmic counting, counting objects, recognizing and naming numbers, ordering numbers, and solving numerical problems (Clements & Sarama, 2014). In this study, early academic skills are a combination of vocabulary, phonological awareness, alphabet knowledge, and number skill.

These skills, which emerge in the early stages of literacy and mathematics, develop in the process and are closely related to later academic success (Duncan et al., 2007). Studies

show that early academic skills differ according to children's sociodemographic characteristics (Miller & Votruba-Drzal, 2013; Harding et al., 2015) and are related to social functioning (Arnold et al., 2012), parenting styles, parent-child academic interaction, parent-school interaction, and social behaviors (Roopnarine et al., 2006). In addition, the cognitive skills support program (İnal Kızıltepe et al., 2017), Pattern-Based Mathematics Education Program (Kandır et al., 2018), Math Games Program (İnal Kızıltepe & Uyanık Aktulun, 2018), and Big Math for Little Kids Program (Kandır et al., 2017) were found to be effective in developing children's early academic skills. It has been reported that cognitive components such as executive function, short-term memory, working memory, and response inhibition predict early academic skills (Montoya et al., 2019).

After self-regulation, language, and early academic skills are presented in the literature review, the study's models and hypotheses are explained.

## Model and Hypotheses

### Language Skills and Self-Regulation

In the language development process, which is considered to be the most important indicator of cognitive development, words are one of the most basic parts of language skills. When children acquire language skills, they first develop the vocabulary of the language of the culture they are in and consequently form the building blocks for the semantic knowledge of their mother tongue (Levey, 2011). Children listen to the sounds in their mother tongue as a receptive language from infancy. Although the receptive language is active in the early years of preschool, expressive language, which includes speaking and writing skills, is passive. In the preschool period, the child uses the concepts he has acquired with the receptive language in expressive language skills (Ezell & Justice, 2005; Levey, 2011). Receptive language and expressive language affect each other mutually in preschool children. According to Vygotsky, this interaction is the union of language and thought. In the process of merging language and thinking, the child acquires new concepts throughout life and uses the new concepts he / she learns by speaking in the expressive language by thinking in the receptive language (Vygotsky, 1978).

In Vygotsky's theory of sociocultural development, the effect of language on concept learning is emphasized as a result of the interaction between the receptive language and the expressive language. Vygotsky (1962) argued that language serves self-regulation in the formation of desirable and planned behavior to facilitate problem-solving. The use of private or self-directed speech guides the person's behavior in the difficult tasks facing them. Therefore, children who have better language skills can be more competent in using

private speech as a self-guiding tool and are likely to show earlier internalization of private speech and regulatory mechanisms, leading to better self-regulation and adjustment (Petersen et al., 2015). Moreover, as language processes are found to be linked with the neural pathways in the frontal lobe, which includes the frontopolar, medial frontal, and dorsolateral prefrontal cortices (Lee et al., 2005), forming the underlying aspects of self-regulation (Pisoni et al., 2008), language skills can foster the development of self-regulation (cited in Petersen et al., 2015). Vallotton and Ayoub (2011) claimed that there is a positive correlation between toddlers' early vocabulary skills and self-regulation in terms of both concurrent and previous vocabulary. Furthermore, Ayoub et al. (2011) found that children with more vocabulary skills show more growth in self-regulation skills compared to their peers. Bohlmann et al. (2015) revealed that vocabulary plays an important role as the leading indicator of self-regulation skills in the preschool period. In a longitudinal study of children aged 18 to 48 months, Roben et al. (2013) reported that babies with better language skills and increased language skills over time seem less angry and that their anger decreases over time. Petersen et al. (2015), and Petersen et al. (2013) asserted that language skills are associated with self-regulation. In this context, the first (H<sub>1</sub>) and the second (H<sub>2</sub>) hypotheses of the study were formed as:

*"H<sub>1</sub>: Receptive language skill positively affects self-regulation."*

*"H<sub>2</sub>: Expressive language skill positively affects self-regulation."*

When the relationships between language skills and self-regulation were examined according to the literature, it was found that language skills and self-regulation skills were associated with early academic skills. The hypotheses formed according to the relationship between these skills were explained in order.

### Language Skills and Early Academic Skills

The academic skills that begin to develop with the acquisition of language skills (Browne, 2007) consist of literacy skills and math skills (Neuman & Dickinson, 2002). Literacy skills and math skills are the basis for children to have a vocabulary, to be aware of the relationship between speech and the writing system, to gain language-related elements such as phonemes, phonological awareness, and alphabet knowledge and to establish a cause-effect relationship between them, to sort and generalize (Albrecht & Miller, 2004; Browne, 2007). Strong evidence has been found in the literature that various structures that can be gathered under the roof of self-regulation (Nilsen & Graham, 2009) in early childhood have a predictive structure in terms of academic success in language, science, mathematics, and literacy (Blair & Razza, 2007; Bull et al.,

2008; Denham et al., 2012; Espy et al., 2004; McClelland et al., 2007; Nayfeld et al., 2013; Ponitz et al., 2009).

Roth et al. (2002) stated that oral language skills are important for early reading. When examined in terms of math skills, it is explained that as the language development of children improves, their (mathematical) conceptual development also improves and that mathematics language is an important predictor of numerical performance (Abedi & Lord, 2001; Purpura & Reid, 2016; Taşkın & Tuğrul, 2014). The development of receptive language and expressive language in early childhood is also associated with the development of children's academic skills in reading, comprehension, and mathematics (Glutting, Kelly, Boehm, & Burnett, 1989 as cited in Sucuoğlu et al., 2008). Based on this point, the third (H<sub>3</sub>) and the fourth hypotheses (H<sub>4</sub>) of the study are as follows:

*“H<sub>3</sub>: Receptive language skill has a positive effect on early academic skills”.*

*“H<sub>4</sub>: Expressive language skill has a positive effect on early academic skills”.*

### Self-Regulation and Early Academic Skills

Self-regulation skills show significant developmental progress in the preschool period (Wanless et al., 2016). Individuals who gain self-regulation skills can set an attainable goal with high self-efficacy, focus on performance, set specific learning goals and select appropriate strategies to achieve these goals, organize learning environments to help them learn, use resources effectively, establish self-learning, observe and intrinsically evaluate their learning process, control their cognitive processing, their behaviors, and important aspects of their environment, and adapt actively to different environments (Pintrich, 2000, 2004; Zimmerman, 2002). In addition, children with developed self-regulation skills show the characteristics of exhibiting appropriate behavior by preventing inappropriate behavior, delaying pleasure, and exhibiting positive behaviors by controlling their emotions more successfully than their peers (Bodrova & Leong, 2019). They value personal progress and deep understanding by linking learning outcomes to factors that they can control themselves and see their mistakes as an opportunity for learning (Perry & VandeKamp, 2000). This enables children to gain skills such as directing and maintaining attention, limiting their impulsive responses, listening, and remembering instructions, focusing on learning, monitoring and controlling, and keeping information in mind (Blair & Raver, 2015; Blair & Ursache, 2011; McClelland et al., 2014). These acquired skills play a fundamental role in conducting academic activities and support children's adaptation to these tasks, especially in reading and mathematics-related activities that require focused attention and problem-solving skills (Blair & Razza, 2007; Matthews et al., 2009). While the acquisition of these skills enables children to acquire many skills in the education process, their failure may cause the

learning of the whole class to be interrupted (Montroy, Bowles, & Skibbe, 2016b; Skibbe et al., 2012). For example, as children with low self-regulation are more likely to exhibit problematic behaviors and are less likely to show social competence (Montroy et al., 2014; Woodward et al., 2017), they can negatively affect the learning process. For this reason, self-efficacy that develops in the preschool period prepares the ground for the development of basic academic skills by allowing children to benefit from learning opportunities by developing appropriate behaviors, and this situation is considered as a predictor of the acquisition of later academic skills (Blair & Raver, 2015; McClelland et al., 2013; McClelland et al., 2014). Based on this point, the fifth hypothesis (H<sub>5</sub>) of the study was formed:

*“H<sub>5</sub>: Self-regulation affects academic skills positively.”*

These five hypotheses to be examined in the study consist of language, self-regulation, and academic skills. When the relationships between these hypotheses are examined, it is understood that self-regulation is the mediator variable between receptive language, expressive language, and early academic skills. In this sense, self-regulation skill, as the mediator variable, is examined below.

### Self-Regulation as a Mediator Variable

Studies (Abedi & Lord, 2001; Purpura & Reid, 2016; Taşkın & Tuğrul, 2014), show that language skills (receptive language, expressive language) affect early academic skills. Self-regulation is affected by language skills and affects early academic skills (Blair & Raver, 2015; Blair & Razza, 2007; Blair & Ursache, 2011; Matthews et al., 2009; McClelland et al., 2014; Vygotsky, 1962). In this sense, self-regulation may have a mediator effect between receptive and expressive language skills and early academic skills. Therefore, the fifth a (H<sub>5a</sub>) and the fifth b (H<sub>5b</sub>) hypotheses were formed as follows:

*“H<sub>5a</sub>: Self-regulation skill is a significant mediator variable between the receptive language skill and early academic skills.”*

*“H<sub>5b</sub>: Self-regulation skill is a significant mediator variable between the expressive language skill and early academic skills.”*

It has been reported that the gender variable affects language skills and also affects self-regulation. Therefore, in the model proposed in this study, it was investigated whether the first (H<sub>1</sub>), the second (H<sub>2</sub>), and the fifth (H<sub>5</sub>) hypotheses show gender-related changes. In this sense, the relationship between gender and the variables of the proposed model is explained below under the title of gender.

### Gender as a Moderator Variable

For many years, studies have been carried out on the difference in preschool children's language skills by gender. Maccoby and Jacklin (1974) stated that girls mature

faster than boys in verbal abilities while Hyde and Linn (1988) explained that there was a small advantage in favor of girls in the meta-analysis of gender differences in verbal abilities, but not a developmental trend.

In studies on gender differences in terms of self-regulation in the preschool period, girls also perform better than boys in behavioral self-regulation (Fung et al., 2019; Guimard et al., 2012; Matthews et al., 2009; Montroy, Bowles, Skibbe, McClelland, & Morrison, 2016a; Størksen et al., 2015; Suchodoletz et al., 2013; Vallotton & Ayoub, 2011). Therefore, the sixth a ( $H_{6a}$ ) and the sixth b ( $H_{6b}$ ) hypotheses were formed as follows:

*“ $H_{6a}$ : Gender has a moderating role in the effect of receptive language on self-regulation skills. The moderating effect of gender is high in girls and low in boys.*

*“ $H_{6b}$ : Gender has a moderating effect in the effect of expressive language on self-regulation skills. The moderating effect of gender is high in girls and low in boys.*

When gender differences in the relationship between self-regulation and academic achievement were examined, it was reported that girls’ self-regulation scores were higher in the USA and Iceland and were associated with academic achievement (Gestsdottir et al., 2014; Ponitz et al., 2009). In China, South Korea, and Taiwan, no gender difference was found in the relationship between self-regulation and academic achievement (Wanless et al., 2013; Zhang et al., 2005). From this perspective, according to the model proposed in this study, it was found out that gender is related to language, self-regulation, and

early academic skills. In this context, the sixth c hypothesis ( $H_{6c}$ ) was created as:

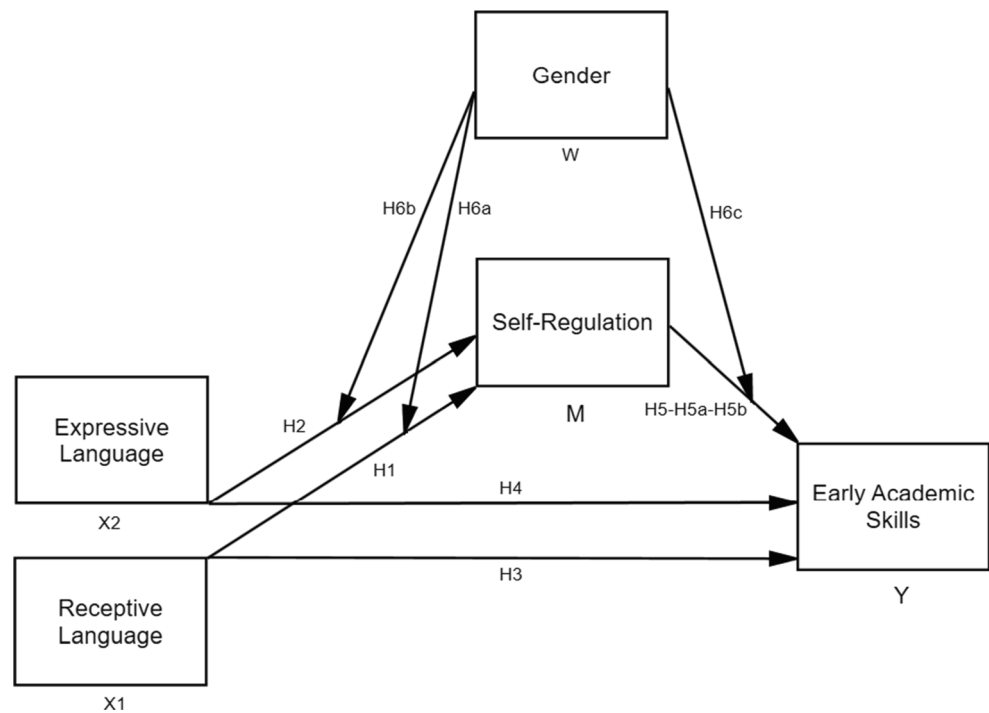
*“ $H_{6c}$ : Gender has a moderating effect on the effect of self-regulation on academic skills. The moderating effect of gender is high in girls and low in boys.*

### The Present Study

In this study, it is thought that language skills affect self-regulation skills, and self-regulation skills affect early academic skills. In this framework, in the model proposed in the study, self-regulation is tested as the mediator variable and gender as the moderator variable. As a result of the literature review, although the relationships between language, self-regulation, and academic skills were investigated using two variables, no study was found regarding the model proposed in the study (see Fig. 1). In the study, the relationship between language skills, self-regulation, and early academic skills is explained in light of the relevant literature. A theoretical model is proposed in light of theories and research explaining the relationships among the variables. The theoretical representation of the proposed model is in Fig. 1.

To explain the proposed theoretical model, the predicted variables are shown with the symbols of receptive language ( $X_1$ ) and expressive language ( $X_2$ ). Early academic skills are indicated by the symbol ( $Y$ ). Self-regulation as a mediator

**Fig. 1** Theoretical representation of the proposed model





variable is represented by the symbol (M). Gender as a moderator variable is shown with the symbol (W). In this sense, this study will investigate the hypotheses created to test the relationships between language skills, self-regulation, and early academic skills in children aged 60–72 months.

In the following parts of this study, the headings are Research Method, Findings, Discussion, Conclusion, Recommendations, and Limitations.

## Method

### Participants

The study consisted of 363 children aged 60–72 months and attending a public kindergarten in Afyonkarahisar and Kars (Turkey) city centers together with 20 pre-school teachers who work with these children. The study's participants were selected using the random sampling method, which is appropriate for the correlational survey method. With this sampling method, the children participating in the study showed typical developmental characteristics and were willing to participate in the study together with their teachers. That is, no developmental retardation or undiagnosed symptoms were observed in the children participating in the study (Karasar, 2009). The distribution of the children's demographic characteristics is given in Table 1.

According to the demographic characteristics in Tables 1, 55.9% of the children lived in Afyonkarahisar and 44.1% of them lived in Kars provincial center. It was seen that 52.6% of the children participating in the study were girls and 47.4% were boys; 49.0% of the participating children were born first, 22.6% born second, 25.3% born third and 3% born fourth. The mean age of children was approximately 67.5 months. The mean age of girls was approximately 67.1 months. The mean age of boys was approximately 67.9 months.

Regarding the demographic characteristics of the teachers participating in the study, it was found that 15 teachers are female, and five teachers are male. When the teachers'

educational level is examined, 14 teachers have an undergraduate degree and six teachers have a postgraduate degree. When the years of seniority are examined according to the teachers' professional experience, five teachers have been in service for 3–6 years, nine teachers for 7–10 years, and six teachers for 10–15 years.

### Procedure

After the aim of the study was explained to the parents and teachers, the necessary consent was obtained from the parents of the children who volunteered to participate. Children's data were collected only by the researchers to protect privacy. Data in the study were collected using a personal information form, K-SEALS, and a teacher's observation form including a self-regulation scale. The researchers applied K-SEALS to the children to collect data on language skills, vocabulary, and early academic skills. When applying K-SEALS, a picture of each item in the test booklet was shown to the children, the instruction for the picture was read aloud, and the children were expected to respond. A score of 1 (one) was given on the test registration form for each correct answer and 0 (zero) for each wrong answer. The test consisted of a total of 90 items and it took between 15 and 25 min for each child. The raw score for each subtest was the number of correctly answered items (Kaufman & Kaufman, 1993). The data took approximately eight weeks to collect.

Data were collected by teachers observing the children and filling out the self-regulation scale. Before teachers filled out the data collection tool, the items were read together, and their comprehensibility was tested. Before the data collection tool was applied, they held activities for seven weeks to get accustomed to the children. Teachers were asked to keep anecdotal records based on their observations for one week before filling out the data collection tool and later they were asked to fill out the data collection tool according to these anecdotes. These data took about three weeks to collect.

### Data Collection Tools

A data collection form consisting of three parts was used in the study. The first part of the form included items about the children's personal information (age, gender, birth order, number of children) prepared by the researchers. In the second part of the form, K-SEALS was applied to the children. In the third part of the form, the self-regulation scale was used. The data collection tools used in the study are described below.

### Personal Information Form

In the study, a personal information form developed by researchers to collect children's personal information was used to determine date of birth, gender, number of siblings, and

**Table 1** Demographic characteristics of children

Variable	Type	n	%
City	Afyonkarahisar	203	55.9
	Kars	160	44.1
Gender	Female	191	52.6
	Male	172	47.4
Birth Order	1	178	49.0
	2	82	22.6
	3	92	25.3
	4	11	3.0

order of birth. The personal information forms for each child were filled out by the researchers according to the information in the personal development files in the schools.

### **Kaufman Survey of Early Academic and Language Skills- K-SEALS**

The original form of the Kaufman Survey of Early Academic and Language Skills was developed by Kaufman and Kaufman (1993). The target audience of the data collection tool is children aged 36–83 months. The psychometric properties measured by the data collection tool are early language, cognitive competence, and academic skills. K-SEALS consists of three subtests: vocabulary (33 items), numbers, letters – words (37 items), and an articulation survey (20 items). It consists of four subscales, namely, Expressive Language Skills (35 items), Receptive Language Skills (35 items), Number Skills (17 items), and Letters & Words Skills (20 items) under the aforementioned tests and Early Academic & Language Skills Compound (70 items), which consists of the Vocabulary, Numbers, and Letters & Words subtests. The items in each of the K-SEALS subtests are scored under different subscales. When scoring the scale, a score of 1 (one) is entered in the test registration form for each correct answer, and 0 (zero) for each incorrect answer. The raw score for each subtest is the number of correctly answered items. When the subtest scores used in this study are examined, the receptive language is scored between 0 and 35 points, expressive language between 0 and 35 points, and early academic skills (EAS) between 0 and 70 points. Uyanık and Kandır (2014) adapted the Turkish form to Turkish children and collected data about the scale. The results of the factor analysis applied to the data set confirmed the one-dimensional factor structure. It was determined that the KR-20 reliability coefficient for K-SEALS was .971 and the item-total correlation coefficient of the majority of items was at a high level of reliability. Test-retest correlation for K-SEALS total was determined as .908. The relationship between the two test results was found to be significant at  $p < .001$ .

### **Self-Regulation Skills Scale for Children Aged 4–6 Years (Teacher Form)**

The Self-Regulation Skills Scale was developed by İvrendi and Erol (2018). The original scale form for 438 children was filled out by 20 preschool teachers. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were performed to determine the construct validity of the scale. In the factoring process performed according to the principal component analysis principle, a three-factor structure, namely, working memory, attention, and inhibitory control was obtained. The scale is a 5-point Likert type including a total number of 22 items (five items for working memory,

nine items for attention, and eight items for inhibitory control). As a result of the CFA analysis applied to test the validity of the scale, the fit indices were found to be sufficient ( $\chi^2/sd = 1.28$ , RMSEA = .046, RMSEA = .046, NFI = .96, CFI = .99, GFI = .84, AGFI = .80 IFI = .99). For the criterion validity of the scale, the Turkish form of the child behavior assessment scale developed by Bronson et al. (1990) and adapted to Turkish by Sezgin and Demiriz (2016) was used. As a result of the criterion validity test, it was determined that concurrent and predictive validity was significant.

The internal consistency coefficient for the measuring tool was examined with Cronbach Alpha. The internal consistency coefficient for the total size of the scale was found to be .94. It was determined that the internal consistency values of the factors of the scale were attention .91, inhibitory control .91, and working memory .87. In light of these results, the data collection tool is understood to be valid and reliable.

### **Validity and Reliability of Data Collection Tools**

The validity and reliability analyses of the self-regulation skills scale used in this research were reconstructed. Reliability analysis of K-SEALS subscales was renewed.

### **Reliability Analysis of the Kaufman Survey of Early Academic and Language Skills - K-SEALS**

Kuder Richardson's internal consistency coefficient was calculated for the Kaufman Survey of Early Academic and Language Skills. The internal consistency coefficient of vocabulary was .785. The internal consistency coefficient of expressive language was .780. The internal consistency coefficient of receptive language was .745. The internal consistency coefficient of K-SEALS was .812. In light of these results, it was determined that the data collection tool was reliable.

Item total correlation and item discrimination indices were examined according to the dimensions of the Kaufman Survey of Early Academic and Language Skills subscales. The item total correlation of the vocabulary subscale was between .435 and .776; the item total correlation of items in the expressive language subscale ranged from .450 to .657; the item total correlation of the items in the receptive language subscale was between .376 and .540, and the item total correlation between the K-SEALS total items was between .312 and .523. In light of these results, it was determined that all items in and subscales of the data collection tool were significantly associated with the scale and subscales ( $p < .01$ ). For the Kaufman Survey of Early Academic and Language Skills, independent samples t test was applied according to the groups with 27% high score and 27% low score. According to the item discrimination values, the t value of the items in the vocabulary subscale ranges from 3.425 to 9.375 and all items show a statistically significant difference between the upper

and lower groups ( $p < .05$ ). The  $t$  value of the items in the expressive language subscale was between 4.913 and 8.430 and there was a significant difference ( $p < .05$ ) between the upper and lower groups. The  $t$  value of the items in the receptive language subscale was between 5.376 and 9.134 and there was a significant difference ( $p < .05$ ) between the upper and lower groups. When the discriminative values of K-SEALS total items were examined, it was determined that they received  $t$  values between 2.975 and 9.230, and the items showed a significant difference ( $p < .05$ ) between the upper and lower groups and were distinctive. According to these results, it was determined that the data collection tool was reliable based on item total correlation, item discrimination, and the internal consistency values of K-SEALS and its subscales.

### Self-Regulation Skills Scale for Children Aged 4–6 Years (Teacher Form)

When the fit index values of self-regulation skills scale examined [ $\chi^2 = 940.032$ ; ( $df = 216$ ,  $p < .001$ );  $\chi^2 / sd = 4.352$ ; RMSEA = .062, NFI = .919, CFI = .920, GFI = .908, AGFI = .912, IFI = .945],  $\chi^2 / sd$  (Anderson & Gerbing, 1984; Kline, 2016), RMSEA (Hu & Bentler, 1998; Jöreskog & Sörbom, 1993), NFI (Hu & Bentler, 1998; Tabachnick & Fidell, 2013), CFI (Tabachnick & Fidell, 2013), GFI (Shevlin & Miles, 1998; Hooper et al., 2008), and IFI (Marsh & Hau, 1996) were found to be within the acceptable value range according to the literature.  $T$  values were examined to determine the significant difference of the items in the self-regulation skills scale. As a result of the CFA analysis, the  $t$  values of the items in the scale were found to range between 12.365 and 17.167. The  $t$  values of the items differed significantly for each item ( $p < .01$ ).

Cronbach's Alpha internal consistency coefficient was used to examine the reliability values of the data collection tool. The internal consistency coefficient of the working memory factor was .895. The internal consistency coefficient of the attention factor was .823. The internal consistency coefficient of the working memory factor was .870. The internal consistency coefficient for the total of the data collection tool was calculated as .898. In light of these results, it was determined that the data collection tool was reliable.

## Data Analysis

### Investigating Assumptions

Before proceeding with data set analysis, missing data, univariate and multivariate normality, extreme values, and multiple linearity values were examined (Tabachnick & Fidell, 2013). As a result of the examination of whether there was missing data in the dataset, it was determined that there was no

missing data. Flatness and skewness coefficients were examined for univariate normality values. It was determined that the kurtosis and skewness values were within normal values. It was determined through scatter diagrams of variables that linearity was met. It was also determined that the multicollinearity and singularity checks of the correlation matrix were significant. Variance Inflation Factor (VIF) and Tolerance (T) and Conditional Index (CI) values were checked to analyze the multiple linearity problem (Tabachnick & Fidell, 2013). It was determined that VIF value was less than 10 (Myers, 1990),  $T$  value was different than 0 (Menard, 1995), and CI value was less than 30 (Paulson, 2007). In light of these results, it was understood that there was no multiple linearity problem.

### Assumptions of Model Suitability

The fit indices determined to evaluate the CFA results made on the self-regulation scale and the validity of the proposed model were as follows: The ratio of chi-square value to the degree of freedom ( $\chi^2/sd \leq 3$ ), Root Mean Square Error of Approximation (RMSEA  $\leq 0.08$ ), Normed Fit Index ( $0.95 \leq NFI \leq 1$ ), Comparative Fit Index ( $-0.95 \leq CFI \leq 1$ ), Goodness of Fit Index ( $0.95 \leq GFI \leq 1$ ), Adjusted Goodness of Fit Index ( $0.95 \leq AGFI \leq 1$ ), Incremental Fit Index ( $0.95 \leq IFI \leq 1$ ). Good fit value ranges of the determined fit indices according to the literature are also given above in parentheses (Anderson & Gerbing, 1984; Hooper et al., 2008; Hu & Bentler, 1998; Jöreskog & Sörbom, 1993; Kline, 2016; Marsh & Hau, 1996; Shevlin & Miles, 1998; Tabachnick & Fidell, 2013). According to the model fit index values, ( $\chi^2 = 2.084$ ;  $df = 2$ ;  $p = .000$ ), the value of  $\chi^2 / sd = 1.04$  was below 3 and it was a good fit indicator. The RMSEA value (RMSEA = .08) matched well. The NFI value (NFI = .96) matched well. The CFI value (CFI = .99) matched well. GFI value (GFI = .98) matched well. The AGFI value (AGFI = .97) matched well. The IFI value (IFI = .98) showed a good fit. Therefore, it is understood that the fit index values of the model had good fit values and the model is at an acceptable level in terms of these model fit values.

### Analysis Method

In the study, structural equation modeling with mediation and moderation was established with observed variables to test whether the mediating variability of self-regulation between receptive language ( $X_1$ ), expressive language ( $X_2$ ), and early academic skills ( $Y$ ) is significant, the moderating role of gender ( $W$ ), and the hypotheses. Structural Equation Modeling (SEM) analysis is a multivariate regression model that reveals causal relationships between observed variables (Kline, 2016). SEM is the study of covariance among the observed variables to make inferences about latent variables (Schreiber

et al., 2006). SEM analysis makes it possible to examine different variables related to models with complex relationships. The model proposal was examined by applying path analysis to the data obtained from the study. SEM analysis makes it possible to determine whether there is a significant cause-effect relationship between the variables of the model proposed from the mixed hypotheses for the study in Fig. 1.

In the proposed theoretical model, the bootstrap method was used to determine whether the mediator variable self-regulation (M) was a significant variation between the predictive variable ( $X_1, X_2$ ) and the outcome variable (Y). It is claimed that the bootstrap method gives more reliable results than Baron and Kenny’s traditional mediation or Sobel mediation tests (Baron & Kenny, 1986; Gürbüz, 2019 ; Hayes, 2018). In the Mediation Test analysis with the bootstrap method with 5000 resamplings and 95% confidence interval, it is argued that the values that do not include the confidence interval 0 are the mediator variables (Gürbüz, 2019; Hayes, 2018).

The variable that affects the direction and intensity of the relationship between the predictive variable and the outcome variable is called the moderator variable (W). For example, if the moderator variable is gender, the effect of the predicted variable on the outcome variable varies depending on whether the subject is a boy or a girl. In this study, the significance of the moderator variable was examined according to the moderating impact analysis with multiple groups. For the analysis of the moderator variable, dummy coding was performed and a value of 0 for girls and 1 for boys was given. The effect of gender, the moderator variable, on the predicted variable and the outcome variable was defined as (a) path in girls and (b) path in boys. The effect of the moderator variable was examined separately for girls (a) and boys (b) according to their

significance level ( $p < .001$ ). Critical ratio differences between parameters (Z value) were examined according to the pairwise parameter comparison of the paths (a) and (b) (binary comparison state of significant difference) to determine whether gender was a significant moderator variable or not. If the critical Z value is greater than 1.96, the moderator variable is significant due to the significant difference between paths (a) and (b) ( $Z > 1.96$ ) (Baron & Kenny, 1986; Frazier et al., 2004; Gürbüz & Bekmezci, 2012; Gürbüz, 2019).

The results obtained from the analysis were evaluated according to the model fit assumptions and various good fit indices. AMOS 23 was used for CFA and path analysis, and SPSS 21 program was used for data set entry, item statistics, and test statistics.

### Results

The study’s findings are presented as follows: first, the relationship between the variables that make up the hypothesis of the study and descriptive statistical values are explained (see Table 2). This is followed by findings showing whether the hypotheses in the research model were accepted or not (see Tables 3, 4 and 5).

From Table 2, it can be seen that the relations among expressive language, receptive language, self-regulation, and early academic skills ( $p < .01$ ) have a significant relationship. Considering the total sample, the highest relationship among the variables is between expressive language and early academic skills. The lowest relationship between variables is between self-regulation and early academic skills. This result among the variables was the same for children in both the boys’ and girls’ groups. It was determined that variables took

**Table 2** Correlations among constructs, means, standard deviations, skewness, kurtosis

Pearson’s r correlation coefficients					Descriptive stats		Normality stats		
Variables		1	2	3	4	M	SD	Skewness	Kurtosis
Whole sample N=363	1. Expressive Language	1				18.15	4.53	.18	.16
	2. Receptive Language	.666**	1			24.37	3.90	.27	.17
	3. Self-Regulation	.567**	.506**	1		91.11	12.75	−.90	.94
	4. EAS	.721**	.788**	.437**	1	42.53	7.71	.44	.43
Girl N=191	1. Expressive Language	1				17.90	4.50	.16	.27
	2. Receptive Language	.644**	1			24.38	3.57	.06	.43
	3. Self-Regulation	.476**	.446**	1		92.42	12.45	−.90	.81
	4. EAS	.723**	.673**	.451**	1	42.28	7.32	.32	.40
Boy N=172	1. Expressive Language	1				18.43	4.57	.19	.07
	2. Receptive Language	.693**	1			24.36	4.25	.40	.45
	3. Self-Regulation	.351**	.373*	1		89.65	12.96	−.78	.88
	4. EAS	.540**	.547**	.345*	1	42.80	8.12	.52	.40

\*\* . Correlation is significant at the 0.01 level (2-tailed)

\* . Correlation is significant at the 0.05 level (2-tailed)



**Table 3** Results of path analysis

Predictive Variables	Outcome Variables										
	Early Academic Skills (Y)					Self-Regulation (M)					Hypotheses
	B	$\beta$	SE	C.R	p	B	$\beta$	SE	C.R	p	
Receptive Language ( $X_1$ )	.891	.311	.294	3.034	.002	.742	.590	.038	40.980	.000	
Expressive Language ( $X_2$ )	.979	.397	.297	3.296	.000	.762	.481	.044	33.437	.000	H <sub>4</sub> / H <sub>2</sub>
Self-Regulation (M)	.547	.550	.040	38.780	.000						H <sub>5</sub>

B=Unstandardized Estimates  $\beta$ = Standardized Estimates.

values between  $-1$  and  $+1$  according to kurtosis and skewness values. In this context, the variables of the study showed normal distribution. AMOS output showing the parameters in the model can be seen in Fig. 2.

Path analysis was applied to test the hypotheses established for receptive language, expressive language, self-regulation, and early academic skills, which are the variables of the study. H<sub>1</sub>, H<sub>2</sub>, H<sub>3</sub>, H<sub>4</sub>, and H<sub>5</sub> analysis results are given in Table 3.

According to Table 3, receptive language affects early academic skills ( $\beta = 0.311$ ; CR = 3.034;  $p < .01$ ) directly and positively. In this context, H<sub>3</sub> is supported. Receptive language affects self-regulation ( $\beta = 0.590$ ; C.R = 40.980;  $p < .01$ ) directly and positively. According to this finding, H<sub>1</sub> is supported. Expressive language affects early academic skills ( $\beta = 0.397$ ; CR = 3.296;  $p < .01$ ) directly and positively. In this context, H<sub>4</sub> is supported. Expressive language affects self-regulation ( $\beta = 0.481$ ; C.R = 33.437;  $p < .01$ ) directly and positively. According to this finding, H<sub>2</sub> is supported. Self-regulation affects early academic skills ( $\beta = 0.550$ ; CR = 38.780;  $p < .01$ ) directly and positively. In this context, H<sub>5</sub> is supported.

Variables in the model (see Fig. 2), self-regulation ( $R^2 = .95$ ) explains 95% of variance, early academic skills ( $R^2 = .48$ ) explains 48% of variance. To determine whether self-regulation is a significant mediator variable in the relationship between receptive language and early academic skills or expressive language and early academic skills (see Fig. 2), the results of H<sub>5a</sub> and H<sub>5b</sub> are given in Table 4 after performing a mediation effect analysis using the bootstrap technique.

According to bootstrap standardized total effect results, when self-regulation was not added as a mediator variable (simple effect model,  $[X_1 \rightarrow Y]$ ), the receptive language was found to affect the early academic skills variable ( $\beta = .335$ ;  $p < .01$ ; 95% CI [0.447, 0.527]) directly and positively. When self-regulation was added as a mediator variable (mediating effect model,  $[X_1 \rightarrow Y; X_1 \rightarrow M; M \rightarrow Y]$ ), receptive language ( $\beta = .024$ ;  $p < .01$ ; %95 GA [0.179, 0.269]) affected the early academic skills variable directly and positively. The simple effect model ( $X_2 \rightarrow Y$ ) in which self-regulation was not added as a mediator variable, expressive language, according to the standardized total effect results, affected the early academic skills variable ( $\beta = .426$ ;  $p < .01$ ; 95% CI [0.575, 0.644]) directly and positively. The mediating effect model ( $X_2 \rightarrow Y; X_2 \rightarrow M; M \rightarrow Y$ ), in which self-regulation is added as a mediator variable, shows that expressive language ( $\beta = .029$ ;  $p < .01$ ; 95% CI [0.199, 0.353]), according to the standardized indirect effect test results (see Table 4), affects early academic skills variable directly and positively.

When Table 4 is examined, it is seen that the coefficient in the self-regulation variable simple effect model decreases in the mediating effect model where both the receptive and expressive language variables are present. Since the upper and lower limits of the confidence interval (CI) in the mediating effect model do not contain 0 value, it is understood that self-regulation is a significant mediator variable between the recipient language and the early academic skills variable. Hence, H<sub>5a</sub> and H<sub>5b</sub> are supported. In this context, when the results of the standardized indirect effect test representing the standardized total effect and the mediating effect model representing

**Table 4** Mediation effect path analysis

Outcome Variable	Predictive Variable										
	Receptive Language Variable ( $X_1$ )					Expressive Language Variable ( $X_2$ )					
	B	$\beta$	95% CI		p	B	$\beta$	95 %CI		p	Hypotheses
			Lower	Upper				Lower	Upper		
Standardized Total Effect	.960	.335	.447	.527	.000	.551	.426	.575	.644	.000	H <sub>5a</sub> / H <sub>5b</sub>
Standardized Indirect Effect	.072	.024	.179	.269	.000	.069	.029	.199	.353	.000	

B = Unstandardized Estimates  $\beta$  = Standardized Estimates CI=Confidence Interval.

**Table 5** Moderator variable effect model path analysis results

Predictive Variable	→ Outcome Variable	Gender (W)										Hypotheses
		Girl (path a)					Boy(path b)					
		B	β	SE	CR	p	B	β	SE	CR	p	
Receptive Language (X <sub>1</sub> )	→ Self-Regulation(M)	1.496	.446	.074	19.042	.000	1.529	.507	.046	32.232	.000	H6a
Z (path b)		.945					–					
Expressive Language (X <sub>2</sub> )	→ Self-Regulation(M)	1.475	.620	.059	26.475	.000	1.654	.568	.043	36.150	.000	H6b
Z (path b)		.035					–					
Self-Regulation R <sup>2</sup>		.939					.978					
Self-Regulation (M)	→ EAS (Y)	.198	.295	.020	9.764	.000	.387	.409	.439	35.124	.000	H6c
Z (path b)		.482					–					
Early Academic Skills R <sup>2</sup>		.989					.352					

B=Unstandardized Estimates β= Standardized Estimates CI = Confidence Interval.

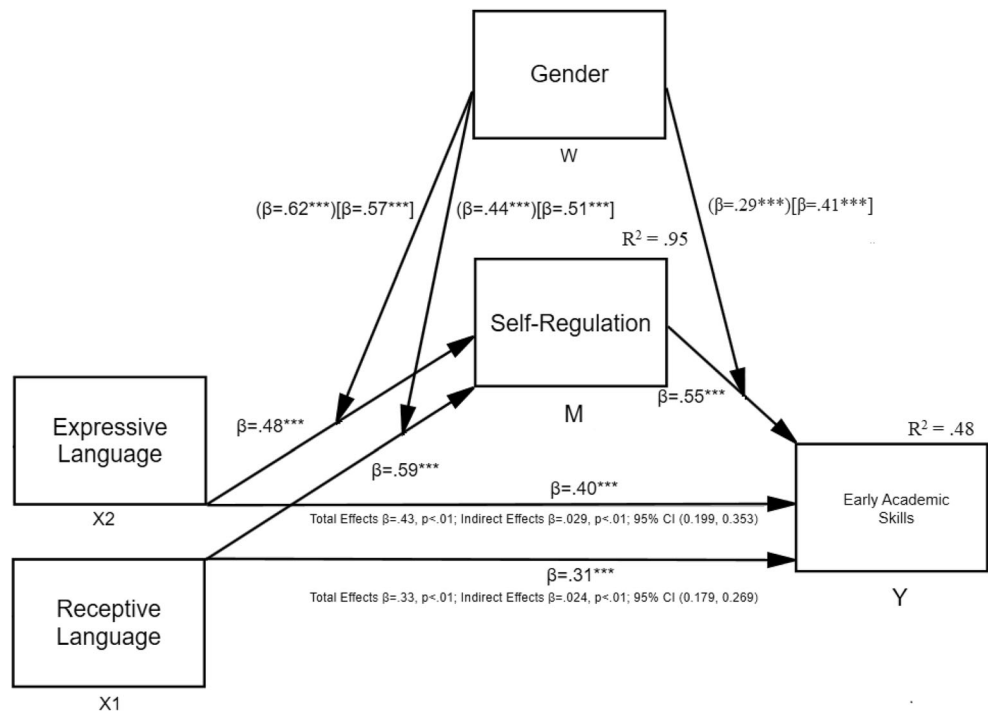
the simple effect model are compared, it is seen that the early academic skills relationship between both the recipient language and the expressive language decreases and the significant difference does not disappear. Therefore, self-regulation is understood to have a partial mediating effect between receptive language and early academic skills.

After conducting a moderating effect analysis to determine whether gender has a moderating role (H<sub>6a</sub>-H<sub>6b</sub>) in the effect of receptive and expressive language on self-regulation and whether gender has a moderating role (H<sub>6c</sub>) in the effect of self-regulation on early academic skills, the findings of H<sub>6a</sub>, H<sub>6b</sub>, and H<sub>6c</sub> are shown in Table 5.

Table 5 shows the moderating role of gender in the effect of the predicted variable on the outcome variable through path (a) for girls and (b) for boys. Receptive language affects self-regulation directly and significantly in girls (β = 0.446; CR = 19.042; p < .01). Path (a) is significant in this sense. Receptive language affects self-regulation directly and significantly in boys (β = 0.507; CR = 32.232; p < .01). Thus, path (b) is significant.

Expressive language affects self-regulation directly and positively in girls (β = 0.620; CR = 26.475; p < .01). Hence, path (a) is significant. Expressive language affects self-regulation directly and significantly in boys (β = 0.568; CR = 36.150; p < .01). Path (b) is also significant in this sense.

**Fig. 2** Standardized estimate values of the model as a result of path analysis. (\*p < .05, \*\*p < .01, \*\*\*p < .001. N = 363), (β = Girl, path a), [β = Boy, path b]



Self-regulation in girls significantly and directly affects early academic skills ( $\beta = 0.295$ ;  $CR = 9.764$ ;  $p < .01$ ). Here, path (a) is significant. Self-regulation in boys affects early academic skills significantly, directly, and positively ( $\beta = 0.409$ ;  $CR = 35.124$ ;  $p < .01$ ). Therefore, path (b) is significant.

When examining whether gender has a moderating role in  $H_{6a}$ ,  $H_{6b}$ , and  $H_{6c}$  or not and the significant difference between paths a and b according to the pairwise parameter comparison result, since critical Z values were less than 1.96 in the effect of receptive language on self-regulation ( $Z = .945$ ;  $Z < 1.96$ ), the effect of expressive language on self-regulation ( $Z = .035$ ;  $Z < 1.96$ ), and the effect of self-regulation on early academic skills ( $Z = .482$ ;  $Z < 1.96$ ), it was concluded that there was no significant difference between a and b paths.

In light of these findings,  $H_{6a}$ ,  $H_{6b}$ , and  $H_{6c}$  have been rejected. In the model proposed in which gender is a moderator variable, self-regulation in girls ( $R^2 = .93$ ) explains 93% of variance, while early academic skills ( $R^2 = .98$ ) explain 98% of variance. While boys' self-regulation ( $R^2 = .97$ ) explains 97% of variance, early academic skills ( $R^2 = .35$ ) explain 35% of variance.

## Discussion

Preschoolers take important steps to develop their cognitive self-regulation. During these years, children learn how to do various tasks and how to approach learning situations. In this process, they manage to offer solutions not only to problem-solving situations they use in a particular situation but also to new problem situations in various settings. However, children may need support when they are unable to solve their new problem situations. In this case, according to Vygotsky, an experienced peer, parent, or teacher can help the child. For the child to be able to solve the problem, his/her cognitive skills must be suitable for that task. If the cognitive skills can perceive the existing problem situation, the child increases learning capacity with the support he/she receives from the environment and enriches the learning experience by transferring new information (Vygotsky, 1962, 1978). Therefore, language has a critical effect on self-learning capacity. In this study, when the effect of language on self-regulation and the development of early academic skills was evaluated according to Vygotsky's cognitive learning theory, the functionality of the theory is revealed. The determination of this relationship between self-regulation, language, vocabulary, and early academic skills also sheds light on the relationship between cognition, skill, and learning. Based on this point, the hypotheses supported in the study are discussed in light of the literature.

According to  $H_1$  and  $H_2$ , receptive language and expressive language skills positively affect self-regulation skills. When we look at these two hypotheses in light of theoretical and

experimental literature, it is understood that self-regulation skill is structurally and functionally multidimensional, based on the definitions and explanations of various theories (Polnariiev, 2006; Boekaerts et al., 2005). It is claimed that self-regulation consists of cognitive, behavioral, and affective dimensions. It is also stated that self-regulation has a motivational dimension (Bauer & Baumeister, 2011; Koole et al., 2011; Posner & Rothbart, 2009). However, language is a cultural element in this study investigating the question of how the language skills of Turkish-speaking children affect their self-regulation skills. For this reason,  $H_1$  and  $H_2$ , in which we examined how language skills affect self-regulation skills, have been discussed in light of Vygotsky's sociocultural theory. According to Vygotsky, self-regulation skill develops as a result of the emergence of "higher mental functions" with the effect of language skill. In Vygotsky's theory, "higher mental functions" are expressed in terms of perception, focused attention, memory, and logical thinking. In this context, it is understood that Vygotsky treated self-regulation with its cognitive dimension (Bodrova, 2006; Bodrova & Leong, 2019). Language experiences provide support for children's self-regulation skill development. With the development of self-regulation skills in children, language skills are taken under control and children ask questions by creating problem situations in their minds for solutions to their own problems. In this process, receptive language skills and thinking play an active role (Casey & Lippman, 1991; Casey & Tucker, 1994). However, the child needs to focus his/her attention on certain stimuli to create questions in his/her mind. While focusing attention on the stimulus, working memory triggers the formation of questions and the mental thinking process for the problem situation that the child faces. In cases that do not attract the attention of the child, mental questioning will not start and working memory will not be active. Therefore, the internal speech process of the receptive language cannot be observed (Meichenbaum, 1984; Schunk & Zimmerman, 1994). In such a situation, children should be presented with problems and they should focus their attention on the problem. However, this situation is not very easy in early childhood because attention and inhibitory control need to be developed to control many stimuli that distract the child.

When studies on language skills and self-regulation dimensions are examined, it is understood that children with high language skills and inhibitory control skills have a high vocabulary and that children with low inhibitory control skills are at risk in terms of language skills (Blair & Razza, 2007; Watson & Bell, 2013). Self-regulation, where vocabulary predicts the development of self-regulation by controlling general cognitive abilities (Vallotton & Ayoub, 2011), and having a wider vocabulary facilitated by executive functions such as regulating synchronous flows of information and changing rule sets when children communicate effectively with others can improve their skills (White et al., 2017). Kuhn et al.

(2016) found that the rate of change in vocabulary starting from 24 to 36 months predicts children's 60-month performance in executive function tasks and explained that the growth of vocabulary increases executive functions (EF). Gandolfi and Viterbori (2020) explained that early regulatory control skills are associated with long-term language outcomes in babies aged 24–32 months. Wolfe and Bell (2004) found that children with high inhibitory control skills also have high language skills. Similarly, they found that language skill is related to performance in tasks that include working memory and inhibitory control (Wolfe & Bell, 2004). Braak et al. (2019) found that expressive vocabulary significantly predicts self-regulation. Salmon et al. (2016) suggested that vocabulary is the basis of children's behavioral self-regulation. Becker, Miao, et al. (2014a) found that behavioral self-regulation is associated with vocabulary scores; Montroy, Bowles, and Skibbe (2016b) reported that children's language skills and self-regulation development were correlated; Fuhs and Day (2011), on the other hand, stated that children with a wider vocabulary perform better in executive function skills when they start preschool. The results of both theoretical and experimental studies are in line with the ( $H_1$ ) and ( $H_2$ ) findings supported in this study. In this context, the language skills of Turkish-speaking children affect self-regulation. This result is similar to the results of research conducted with English-speaking children. This situation shows that language is acquired in culture and reveals its relationship with higher mental functions. According to the point of view of Vygotsky's theory, while cultural transfer takes place with language, mental processes develop with the use of that language.

In this study, the effect of language skills on early academic skills in Turkish-speaking children was examined for hypotheses ( $H_3$ ) and ( $H_4$ ), and the effect of self-regulation on academic achievement in Turkish-speaking children was examined for ( $H_5$ ). Early academic skills include the ability of children to identify the names or actions of objects or to point to or name objects based on verbal descriptions of the properties of objects or actions, to point to letters or words, to name and identify letters and to read words, to point to the correct number or object, define numbers, count, demonstrate knowledge of numerical concepts (least/half) and evaluate number problems (Kaufman & Kaufman, 1993).

According to Vygotsky (1962), who argued that the development of language skills in children had an impact on learning, language was a specialized tool of the mind and an important element in learning. Findings related to the third and the fourth hypotheses ( $H_3$ - $H_4$ ) of the study showed that the positive effect of receptive language and expressive language skills on academic skills was supported. In this context, according to the study conducted by Roth et al. (2002), the researchers applied oral language measurements to 39 children in three areas (linguistics, structural language, and narrative discourse) to clarify the relationship between oral

language and early reading development. According to the results of the regression analysis, it was determined that semantic abilities predicted the reading comprehension skills in the 2nd grade, the phonological awareness skill in kindergarten, the reading of a single word in the 1st and 2nd grades, and later understanding the paragraphs. In their study on the importance of language on mathematics word problems in test performance, Abedi and Lord (2001) found that English language learners (ELL) scored less than those who spoke English sufficiently in the math exam and that linguistic change in the test items resulted in significant differences in mathematics performance. Taşkın and Tuğrul (2014) found that there was a relationship between language skills and the development of mathematical concepts in preschool children. In the study in which Purpura and Reid (2016) aimed to determine whether early arithmetic knowledge development was affected by language skills, although general language performance was a significant predictor of numerical performance in the beginning, only mathematics was an important predictor of numerical performance when both mathematical language and general language were included in the model. In this context, the language component of early academic skills revealed the effect of learning concepts specific to mathematics.

Larney (2002) evaluated the findings of four longitudinal studies in order and evaluated the values that showed evidence of continuity between the early language delay and subsequent literacy difficulties. According to the analysis, although there is strong evidence for correlation between early language delay and later reading difficulties for all children with early language delay, some of these reading difficulties are mild; another finding is that the probability that children with early language delay may later experience literacy difficulties largely depends on the age of the child with the language disorder and the severity of the disorder. It was concluded that language delay was a key risk factor for subsequent literacy difficulties in the early years. Crain-Thoreson and Dale (1992) studied the language and literacy skills of 25 children who developed early verbal development at 20 months of age. Although children developed verbally early, their reading rates were lower. Exposure to letter names and sounds was an important predictor of children gaining skills in print awareness, invented spelling, and phonological awareness skills. It was determined that the frequency of reading stories at home and being included in a story reading process at 24 months were important predictors of language skills of children aged 2½ and 4½. It was concluded that reading stories together with parents and literacy education contributed to the development of literacy in verbally developed children.

In this study, children's receptive language ( $H_3$ ) and expressive language ( $H_4$ ) skills were seen to affect early academic skills. This result is similar to the literature (Blair & Razza, 2007; Bull et al., 2008; Denham et al., 2012; Espy et al., 2004;



McClelland et al., 2007; Nayfeld et al., 2013; Ponitz et al., 2009). Another hypothesis ( $H_5$ ) examined in the study was the effect of the self-regulation skill on early academic skills.

In the literature, strong findings have been reached showing that the various structures that can be gathered under the umbrella of self-regulation in early childhood are predictive of academic achievement. McClelland et al. (2006) explained that learning-related skills such as attention, working memory, self-control, and social-emotional competence predict the literacy and mathematics skills of children from kindergarten to 6th grade. McClelland et al. (2007) found that behavioral regulation skills, which include the skills of paying attention, following instructions, and suppressing inappropriate actions, which fall under self-regulation, predicted literacy, vocabulary, and mathematics skills. Welsh et al. (2010) found that cognitive regulation has a unique effect on mathematics and reading knowledge in their study on controlling language development. Bierman et al. (2008) stated that executive functions are important predictors of the acquisition of language and literacy skills. McClelland et al. (2006) determined that skills related to learning such as attention, working memory, inhibitory control, and social-emotional competence predicted literacy and mathematical skills from kindergarten to 6th grade. It has been reported that working memory plays a key role in reading comprehension (Swanson & Jermane, 2007), and that working memory plays a key role in mathematics competence (Cragg & Gilmore, 2014). Becker et al. (2014a, b) explained that behavioral self-regulation is related to mathematics, early literacy, and vocabulary scores. Lonigan et al. (2017) found strong evidence that self-regulatory processes are linked to early academic skills, both simultaneously and longitudinally. Skibbe et al. (2019) determined that children who demonstrate self-control in the preschool period have higher language and literacy skills from preschool to 2nd grade. According to Birgisdottir et al. (2020) self-efficacy predicts children's 1st- and 4th-grade reading and mathematics skills. Wagner et al. (2021) found that the self-regulation skills of preschool children significantly predicted both reading and mathematics performance. However, it has also been reported in many studies that the awareness skill is associated with self-regulation in the preschool period (Allan & Lonigan, 2011; Lonigan et al., 2009; Matthews et al., 2009). Furthermore, some studies show that self-regulation skills in the preschool period predict mathematics skills more than reading skills (Blair, Ursache, Greenberg, & Vernon Feagans, 2015; Braak et al., 2019; Ivrendi, 2011; Matthews et al., 2009; Ponitz et al., 2009; Schmitt et al., 2017; Wanless et al., 2011; Birgisdottir et al., 2020). In light of research carried out so far, it can be said that self-regulation has a positive effect on the development of academic skills. Therefore, the fifth hypothesis ( $H_5$ ) of the study parallels the results seen in the literature.

It was found in this study that language skills and self-regulation affect early academic skills. Language affects self-regulation from Vygotsky's perspective while self-

regulation affects early academic skills. Therefore, it can be said that self-regulation plays a mediating role in affecting academic skills together with language skills. When children with low self-regulation skills start school, it is observed that their social, emotional, and academic skills and school readiness are insufficient (Bodrova & Leong, 2019; Smith-Donald et al., 2007). In this context, language and self-regulation skills should be supported for children's school readiness and their acquisition of social, emotional, and academic skills. According to the results of  $H_{5a}$  and  $H_{5b}$  in this study, it was determined that the self-regulation skill has a partial mediating effect between language and early academic skills. In this case, supporting children's language skills will directly affect both self-regulation and early academic skills. Therefore, it would be expected that children have higher academic success during their school years. So, it may be understood from the result of this study neither self-regulation nor early academic skills may develop if children's language skills are not supported. Therefore, children who do not develop self-regulation may become adults who do not have the skills to adapt to life in their later years, as they are inclined to turn to crime, become addicted to harmful substances, spend excessive money and eat excessively, postpone their responsibilities, not act in accordance with social morality, and fail in social relations (Baron & Dickerson, 1999; Duckworth & Kern, 2011; Gailliot et al., 2007; Gailliot et al., 2010; Gino et al., 2011; Martins et al., 2004; McQuade & Gill, 2012; Sussman et al., 2003). Therefore, it is critical to support children's language and self-regulation skills in early childhood years. Starting from Vygotsky's view, we should point out that play is an effective way for parents and teachers to support children's language and self-regulation skills in early childhood. According to Vygotsky, children can develop both language and self-regulation skills by playing games (Bodrova & Leong, 2019; Bronson, 2000). Therefore, the play needs of preschool children are expected to be met by adults.

In the study, the effect of language skills on self-regulation skills and the moderating role of gender in the effect of the self-regulation skill on academic skills were examined ( $H_{6a}$ ,  $H_{6b}$ , and  $H_{6c}$ ). Related studies (Allan et al., 2017; Barbu et al., 2015; Eriksson et al., 2012; Wallentin, 2009) have shown that there is a difference between the language skills of girls and boys and that the performance of girls is higher. Eriksson et al. (2012), in their study investigating gender differences in language skills in 13,783 European children from 10 non-English language communities, stated that girls are slightly ahead of boys in early communication gestures, productive vocabulary, and combining words and this difference increases with age. Similarly, it was found that girls have a better vocabulary than boys in the preschool period (Allan et al., 2017; Barbu et al., 2015; Wallentin, 2009). In this study, receptive language and expressive language skills affect self-regulation skills in both girls and boys. However, in this study, gender was not found

to be a significant moderator variable in the effect of language skills on self-regulation. Therefore,  $H_{6a}$  and  $H_{6b}$  are rejected.

Although studies conducted in the USA have found gender differences in behavioral self-regulation, the difference is less pronounced or absent in France, Germany, Portugal, and Asian societies (Gestsdottir et al., 2014; Holmes et al., 2016; Merritt et al., 2012; Wanless et al., 2013). In studies on behavioral self-regulation tasks and academic achievement, gender did not cause differences in children aged 3–6 in the United States (Becker et al., 2014a, b; Schmitt et al., 2014; Tominey & McClelland, 2013). Similarly, in Germany, France, and Portugal, no difference was found in the relationship between self-regulation and academic achievement for girls or boys (Baptista et al., 2016; Gestsdottir et al., 2014; Suchodoletz et al., 2013). In this study, it was determined that self-regulation skills affect early academic skills in both girls and boys, but gender does not have a moderating role. Hence,  $H_{6c}$  is also rejected.

## Conclusion

According to the hypotheses established as a result of the literature review, it was determined that language skills, self-regulation, and early academic skills were significantly associated with each other. The self-regulation added to the simple effect model, where receptive language and expressive language skills affect early academic skills, shows a partial mediator variable effect. However, in the model, where receptive language and expressive language skills affect self-regulation and self-regulation affects early academic skills, gender shows no moderating variable effect.

According to the model proposed in the study, early academic skills that explain 48% of the variance are affected significantly and positively by receptive language, expressive language, and self-regulation skills. Self-regulation skills, which explain 95% of the variance in the study, are affected by expressive language and receptive language skills. While it explains 98% of the variance of early academic skills and 93% of self-regulation skills in girls, it explains 35% of the variance of early academic skills and 97% of self-regulation skills in boys.

According to the threshold values of the explained variances proposed by Cohen and Cohen (1983) ( $R^2 = .01$ , small effect size;  $R^2 = .09$ , medium effect size;  $R^2 = .25$ , large effect size), the variance explanation of the variables in the model of the study addresses a large effect size.

According to the model proposed in the study, supporting language skills is critical in the development of early academic skills and self-regulation skills. However, it should be kept in mind that self-regulation has a mediating effect in supporting early academic skills. From this point of view, it was concluded that language, which is a specialized mental tool, should be

supported within a cultural context for self-regulation skills to affect early academic skills.

## Suggestions

The development of educational programs that support receptive language, expressive language, and self-regulation skills is a critical suggestion of the study in supporting the development of children's academic skills. Since self-regulation skills are found to be related to the development of the child's language skills, the development of educational materials and games that support language activities will ensure the development of children's working memory, attention, and inhibitory control. The most critical suggestion made by the study is to develop the skills of parents and teachers to communicate effectively with children because, according to Vygotsky, adults play an important role in bringing solutions to children's various problems. Therefore, it is recommended to conduct research on guidance strategies between children and adults and to provide training on communication strategies. Future research may test the research model proposed in this study by redesigning it according to different theories or research results.

## Limitations

The development of self-regulation, language, and early academic skills is very fast in early childhood. This being so, the most obvious limitation of this study is that children are observed at a certain period and the research model is not tested on different age groups. Quantitative data should be supported by observations on different age groups. Data regarding the children's self-regulation levels were collected through the teachers' observational records. Therefore, subjectiveness might have occurred leading to an error in findings which can be considered as one of the limitations of this study.

**Data Availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Ethics Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Consent to Participate** All participants provided informed consent prior to participating in the study.

**Conflict of Interest** No potential conflict of interest was reported by the authors.

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