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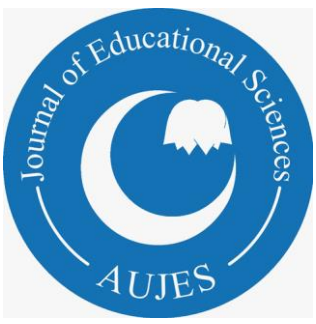

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The Participation and Planning of the Instruction Competencies of Teacher Candidates in the Blended Curriculum Development in Education Course

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Abstract

This study aimed to predict the final scores of teacher candidates through grades obtained from competency in preparing lesson plans, the number of reflections on the discussion board, and the perceived level of proficiency in planning the instruction in the blended Curriculum Development in Education course. This study was designed according to relational survey research design and included 147 teacher candidates. In the study, data were collected through lesson plans, the number of reflections on the discussion board, final scores, and the perception of proficiency in planning the instruction scale and analyzed using the Multiple Linear Regression analyzes. This study found positive and significant correlations among the final grades of teacher candidates, grades obtained from competency in preparing lesson plans, the number of reflections on the discussion board, and the perceived proficiency of teacher candidates in the planning the instruction scale. However, only the grades of teacher candidates obtained from lesson plans significantly predicted the achievement of teacher candidates. It might be inferred that as teacher candidates participated in online discussions, they learned the subjects deeply, prepared better plans, and obtained higher grades from the preparation of lesson plans and final exam.

Keywords: Blended Learning, Curriculum Development in Education Course, Online Discussion, Teacher Competencies

Introduction

The education system consists of important components that complement each other, and if one of them fails, this affects other components and leads to the change of the entire system. One of these important components of the education system is the teacher. A qualified teacher is also an indicator of qualified education (Karagoz et al., 2017).

Moreover, within the scope of the teaching profession, teachers are expected to be experts in their field, in other words, they must have obtained professional competencies (Hagger & McIntyre, 2006; McDiarmid & Crevenger-Bright, 2008). While professional knowledge is more about having field knowledge, professional skills are related to the skills of planning, managing, coordinating, creating learning environments, teaching and learning processes, methods, techniques, materials, and measurement and evaluation (McDiarmid & Clevenger-Bright, 2008, p. 134). In the literature, some of the qualifications of teachers were explained as content knowledge, pedagogical knowledge, and the use of teaching skills (Bransford et al., 2005; Caena, 2011). Furthermore, the Interstate Teacher Assessment and Support Consortium (InTASC) (2013) stated some of the teacher qualifications as ‘content knowledge’, ‘planning of teaching’, and ‘instructional strategies’. InTASC (2013) explained ‘planning of teaching’ as the skills of teachers to plan instruction by including content knowledge, curriculum, interdisciplinary skills, teacher’s professional knowledge as well as knowledge of students and society to achieve the desired level of educational objectives for each student (Council of Chief State School Officers, 2013). Besides, teacher competencies proposed by the European Commission (2013) stressed the ‘content knowledge’, ‘planning, managing and coordination of teaching’ and ‘using teaching materials and technologies’ as some of the important competencies.

In Turkey, the Teaching Profession General Competencies document of the Ministry of National Education-MONE (2017) defines some of the important competencies of teacher properties as ‘planning of instruction, preparation of materials, organizing learning environments organizing extra-curricular activities, etc.’ Erden (2017) classifies the professional qualifications of the teacher as "general culture, subject area knowledge, professional skills, and competencies", while the professional skills and competencies are "planning the teaching process, bringing diversity, using the teaching time effectively, organizing the teaching environment according to the needs of participants and monitoring the development of students ”. The common skill among all these pre-mentioned different explanations is the teachers’ planning competencies.

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Planning the instruction is the best way to organize a lesson or unit for effective instruction and it is among the most important aspects of teaching since it is one of the major determinants of what is taught in schools and how it is taught (Arends, 2012; Li & Zou, 2017; Sprinthall, & Sprinthall, 1990). Lesson plans reveal the beliefs, understandings, and orientations of teachers about the curriculum, the subject in question, the learners, pedagogy, etc. (Davies & Rogers, 2000; Li & Zou, 2017). In other words, lesson or activity planning is central to the professional role of the teacher in reflecting on the personal theory and professional thinking (Davies & Rogers, 2000). Accordingly, Oguz (2009) stated that the lesson plans prepared by the teachers who implement the discovery learning approach and the lesson plans prepared by the teachers who teach through presentation or implement multiple intelligence theory will have different characteristics. Planning aims to ensure the realization of goals and objectives of education by providing learners with more permanent, meaningful, and effective learning opportunities (Arends, 2012; Davran, 2020; Pelton, 2007). According to Farrell (2013), teachers plan lessons for the efficiency of instruction, to respond to the needs, challenges, and interests of learners, to preclude some problems before they arise, and to carry on smoother courses. Moreover, planning instruction is about developing a lesson plan that guides teachers' professional teaching experiences by transforming the factual, conceptual, and operational knowledge learned in faculties of education into models based on their understanding (Kablan, 2012). A lesson plan is defined as a plan that indicates one or several lesson purposes, content, teaching- learning principles, teaching methods, materials, discussion questions, assignments, and evaluation procedures (Karagoz et al., 2017). As stated in the previous definitions, defining the objectives of the course, content, learning-teaching principles, methods, materials, discussion questions, assignments, and evaluation procedures are the topics of the Curriculum Development in Education course. The teacher candidates learn about planning first in this course and implement their plans in the teaching practicum course.

Moreover, Tsui (2009) added to the importance of planning the instruction in dealing with the multidimensionality, simultaneity, immediacy, and unpredictability of classroom events. In other words, careful planning of instruction can enable the smooth execution of lessons. In this direction, the lesson plans can be seen similar to a road map since they make a significant professional contribution for increasing the efficiency of teaching, preventing undesirable behaviors in the classroom, and managing time effectively (Arends, 2012; Demirel, 2017). Teachers are encouraged to plan their lessons comprehensively since defined goals help the teacher to determine the proper methodology for the subject matter to foster the teaching-learning process (Dorgu, 2015). In addition to these, planning the instruction provides emotional confidence to teachers and enables them to monitor, evaluate and correct their teaching activities (Karagoz et al., 2017; Senemoğlu, 2015).

In terms of planning, there are different theoretical and practical studies conducted in the literature (Asiroglu & Koc-Akran, 2018; Atik-Kara & Saglam, 2014; Karagoz et al., 2017; Toman & Basaran, 2019). While the results of some studies revealed that the courses conducted according to lesson plans yielded more clear and effective results (Li & Zou, 2017; Yurtseven, 2019), others revealed negative attitudes or lack of knowledge of teacher candidates in terms of planning. Karagoz et al., (2017) found that teacher candidates had difficulties in writing the parts of plans such as drawing the attention of students, the transition to the lesson, teaching the lesson with activities and evaluation. Also, their plans lacked harmony in terms of the components of planning. Similarly, Çolak and Yabaş (2017) discovered that, while teacher candidates attempted to incorporate constructivist elements into their plans, they were unable to implement an instructional process compatible with constructivism. Furthermore, Tatar and Ceyhan (2018) revealed that teacher candidates had a lack of knowledge in terms of implementing the curriculum in the Teaching Practicum course, ignored the misconceptions of students related to the Science course during the planning and implementation phases, and mostly preferred teacher-centered teaching methods and techniques. Similarly, Davran (2020) concluded that teacher candidates mostly preferred the presentation, besides the question-answer technique in their lesson plans, and their tendency to use traditional methods was prevalent. Yurtseven (2019) revealed some of the weaknesses of teacher candidates as transferring knowledge to the planning process, and a lack of awareness about planning. In addition, Oguz (2009) investigated the views of 122 English teacher candidates who were studying at the Certificate Program in English Language Teaching, about preparing lesson plans. According to responses, more than half of English teaching teacher candidates preferred using ready-made plans, and half of them thought that experienced teachers did not need to prepare a written plan every day. Besides, the majority of teacher candidates agreed that plans prepared by teachers could not be implemented effectively because they were full of unnecessary and showpiece knowledge, and most of the prepared plans were not functional in practice. Similarly, in the study conducted by Farrell (2013), teachers found spending much time planning a lesson a waste of time.

However, the results of the research indicated that the competency levels of the teacher candidates in lesson planning positively affected their implementation skills (Asıroglu & Koc-Akran, 2018; Kablan, 2012; Unver, 2002). Moreover, teacher candidates' cognitive learning and experiences were reflected in preparing lesson plans as well as in the lesson plan implementation skills. In addition, with the changing curricula in 2005,

teachers' guidebooks replaced the obligation to prepare lesson plans for teachers (MONE, 2005). Teacher guidebooks are supplementary materials that show how the lesson will be handled, how the activities in the textbooks will be applied, and which of these activities correspond to the objectives in the curricula. However, the execution of some of the elective courses and extra-curricular activities depends on the planning skills of teachers (Karagoz et al., 2017) which again shows the importance of teachers' planning competencies and skills. For these reasons, it is considered important that planning has an important place in the development of teachers' professional competencies. For this reason, the planning competencies of teacher candidates were investigated concerning their course knowledge (about the components of planning) and course activities that are conducted to strengthen their knowledge about planning the instruction and lesson plan preparation skills in the Curriculum Development in Education course. In this sense, it is thought important to investigate the course knowledge levels of teacher candidates according to the parts of plans: objectives, content organization, teaching-learning processes, and assessment, and by planning the Curriculum Development in Education course according to blended learning, teacher candidates were provided with opportunities to practice course content outside the class.

Blended Learning

Blended learning combines the benefits of traditional classroom learning and online learning into an enhanced teaching method (Jonker et al., 2020; Cheung & Hew, 2011). Many studies about planning the instruction were conducted in courses including only the face-to-face part (Asıroglu and Koc-Akran, 2018; Kablan, 2012; Unver, 2002; Zafeiriou et al., 2001). However, course time is limited to present concepts and includes activities and group work. Moreover, as stated by Talbert (2014), traditional teacher training classes mostly provide limited time for instructors outside of the classroom to answer the questions of learners and correct their mistakes while they are working on a task. For this reason, in the current study, it was thought that by including an online component through online discussions, teacher candidates would have opportunities to practice theoretical learning conducted in class and communicate with the instructor and their peers in terms of asking questions and receiving feedback, as also stated by Hrastinski (2007). This would, in turn, provide time for in-class activities and increase learning.

By including an online part, learners can access online materials wherever they want, whenever they have time, and have the opportunity to store all the dialogs conducted among instructors and students (Ebrahimi et al., 2016; Fleming, 2008; Jonker et al., 2020; Zafeiriou et al., 2001). Online learning environments are suitable for reflection and discussion of complex ideas thanks to the increased communication and social exchange among instructors and students (Alzahrani, 2017; Cheung & Hew, 2011; Fleming, 2008; Hrastinski, 2007; Zheng & Warschauer, 2015). Furthermore, since learners exchange text-based messages through discussion boards, they have more time to think, search, and reflect before contributing to the discussions (Branon & Essex, 2001; Brooks & Jeong, 2006; Fleming, 2008), which promote problem-solving and critical thinking skills (Cheung & Hew, 2011; Ebrahimi et al., 2016). On the other hand, during traditional discussions, there is often insufficient time for students to structure their responses to questions asked in class, which mostly results in shallow and less critical contributions (Fleming, 2008; Hew & Cheung, 2003). It was revealed that online learning improved student learning and achievement in a wide variety of courses and countries, besides other cognitive and affective variables (Alzahrani, 2017; Ryan, 2013; Seethamraju, 2014; Zheng & Warschauer, 2015).

Sing & Khine (2006) integrated an asynchronous communication platform to develop the understanding of teachers about information technology integration. In this sense, teachers prepared lesson plans individually, and they shared them on the asynchronous communication platform to take the ideas of other teachers through posting. In this way, they could connect the lesson plan content to their readings and refine them. In the asynchronous online course from three universities in Taiwan, Wei et al. (2015) revealed the direct effect of education students' number of postings on the discussion board on students' online learning performance (online-discussion scores, exam scores, and group-project scores) in the asynchronous online course. However, Song and McNary (2011) found no correlation between the number of posts and student achievement in a graduate-level online course. Similarly, Cook and Germann (2010) found that the number of postings to discussions did not correlate significantly with the final grades for the upper-level course for advanced majors. It can be seen that there is not enough satisfaction with the findings of studies to be able to say exactly what contribution online discussions has on teacher candidates' online learning performance, such as the grades they obtain from the final exam, lesson plan preparation, number of reflections on the discussion board, and perception of proficiency in planning. For this reason, in the current study, the planning the instruction competencies of teacher candidates were also investigated in relation to the number of reflections on the discussion board. In other words, this study also investigated the relationship between the participation levels of teacher candidates in the online part of the course and their planning competencies, course knowledge, and planning the instruction perceptions in the blended Curriculum Development in Education course.

Purpose and Importance

This study aimed to investigate the planning the instruction competencies of sophomore teacher candidates' in the blended Curriculum Development in Education course and, consequently, to predict the final scores of teacher candidates through the lesson plan grades, the number of reflections on the discussion board, and the scores obtained from the perception of proficiency in planning the instruction scale. For this purpose, the answer to the following question was sought:

How well do the lesson plan grades, the number of reflections on the discussion board, and the scores obtained from the perception of proficiency in planning the instruction scale predict the final scores of teacher candidates in the Curriculum Development in Education course?

Method

In this study, a relational survey research design was implemented (Cohen et al., 2007; Fraenkel & Wallen, 2009) to predict the final scores of teacher candidates through the lesson plan grades, the number of reflections on the discussion board, and perception of proficiency in planning the instruction scale.

Study Group

The study was conducted in the fall semester of the 2019-2020 education year at a state university located in the Aegean Region in Turkey. In this study, the convenience sampling method, which is a type of purposive sampling method, was employed to choose teacher candidates from those who were easy to reach and suitable for the purposes of the study (Cohen et al., 2007; Gall, et al., 2003). Among 147 teacher candidates, 104 (70.7%) were female and 43 (29.3%) were male. Moreover, the distribution of 147 teacher candidates according to their department was shown in Table 1.

Table 1. The Distribution of Teacher Candidates according to their Departments

Department	f	%
Psychological Counselling and Guidance Department	45	30.6
Elementary School Mathematics Teaching Department	22	15.0
Turkish Language Teaching Department	22	15.0
Social Sciences Teaching Department	26	17.7
Classroom Teaching Department	32	21.8
Total	147	100

Data Collection

This study was conducted at an Educational Sciences course called Curriculum Development in Education which is a two-hour elective course for teacher candidates who enrolled in any departments of Faculties of Education in Turkey. In this study, the course included both face-to-face and online discussion dimensions, and the Course Management System, discussion board-Edmodo was used. The activities conducted inside and outside of the class were shown in Table 2.

Table 2. The Activities Conducted Inside and Outside of the Class

Weeks	Subject	*The Activities Conducted Inside and Outside of the Class*
1	Orientation week	• Information about the course applications and materials was provided. • Membership from the course management system-Edmodo was provided.
2	Basic concepts related to curriculum development	• Group discussion about concepts related to curriculum development. • Completion of group assignment about basic educational concepts (Examples about teaching, learning, formal, informal education, curriculum).
3	Types of curriculum, plans	• Investigating the types of curricula like teaching curricula, plans like annual plans, lesson plans, and their properties on the internet. • Group discussion about parts of plans: the goals and objectives of the unit, content, teaching-learning activities, and evaluation.

4	The basics of curriculum development	• **Online discussion** about the importance of basics of curriculum development (such as the history of curriculum development, philosophies of curriculum development, etc...)
5	The responsibilities of groups	• Group discussion about the responsibilities of different groups formed during the curriculum development process.
6	Curriculum development design approaches and models	• **Online discussion** about the positive aspects and limitations of different curriculum development design approaches and models.
7	The needs analysis process	• **Online discussion** about different need analysis approaches and techniques in the curriculum development process.
8	Classification of objectives	• Completion of group assignment about the classification of objectives in terms of the steps of cognitive, affective, and psychomotor domains of Bloom's taxonomy from different class levels of yearly plans related to Mathematics, Life Science, Turkish, Social Sciences, Science and Technology, etc.
9	The organization of content.	• **Online discussion** about the positive and negative aspects of different content organizations.
10	The implementation of different instructional models, strategies, and techniques	• Completion of group assignment about the preparation of a sample lesson plan by implementing different instructional models, strategies, techniques compatible with the objectives of different courses. • **Online Discussion** about the variables affecting the quality of education (cueing, reinforcement, feedback, feedback, and correction) by providing examples of the variables affecting the quality of education.
11	The implementation process of the curriculum	• Group discussion about the implementation process of the curriculum and teachers' role during curriculum development and implementation.
12	The evaluation process of curriculum	• Implementation of jigsaw methods about different types of curriculum evaluation models. This study included home groups. After discussions in specialist groups about the properties, positive aspects, and limitations of different curriculum evaluation models, a small discussion in home groups took place including question-answer activity. Then, an **online discussion** part took place to deepen the knowledge about different curriculum evaluation models.

The face-to-face part of the course required the gathering of teacher candidates in the classroom to learn the course content through the presentation of the instructor using PowerPoint slides, followed by question-answer time besides collaborative group activities. The online part of the course included asynchronous discussions about the course topics for six weeks as shown in Table 2. The weekly discussion topics were placed on the discussion board, and teacher candidates were asked to send their reflections on the discussion board about the topic of the discussion, as shown in Figure 1. The aim of the online part was the enrichment of learning and increase the retention level of teacher candidates. Online discussions allowed the teacher candidates to send messages about the discussion topic and also send messages to each other's reflections, communicate in real-time with online chats, edit their messages, and see the instructor's messages, questions, and announcements. In other words, they learned the topic during the face-to-face part of the course, and then they practiced their learning through online discussions. As can be seen in Table 3, teacher candidates practiced and deepened what they learned in class outside of the formal class time to spare more time for collaborative and interactive activities in the formal class time.

Figure 1. Online discussion board

Data Collection Instruments

In the study, data were collected through lesson plans prepared by teacher candidates, the number of reflections on the discussion board, final scores, and perception of proficiency in planning the instruction scale. The lesson plans were expected to be prepared by considering the different stages of planning consisting of introduction (drawing attention, motivation, and the transition to the course), development (realization of course objectives by including appropriate teaching-learning strategies, methods, techniques, and appropriate materials) and conclusion (summarizing, evaluation, and giving homework) and submitted at the end of the semester. Lesson plans were graded by the course instructor using a rubric (see Appendix 1) according to the pre-mentioned consistency among the parts of the lesson plan such as the objectives of the course, content, learning-teaching principles, methods, materials, discussion questions, assignments, and evaluation procedures. The rubric was developed by the researcher to score the lesson plans of teacher candidates. Before grading their lesson plans, expert opinion was obtained in terms of the clarity, readability, and appropriateness of criteria for the aim of the study from two faculty members in the Curriculum and Instruction Department. Sample lesson plan formats were introduced to the teacher candidates, but there was no obligation to prepare lesson plans according to a specific format since Unver (2002) expressed that the insufficiency of fourth grade Pre-school Teaching Department teacher candidates in preparing lesson plans might be caused by the obligation to prepare lesson plans according to a uniform model.

Teacher candidates' final exam scores were obtained by the course instructor. The final exam consisted of multiple-choice questions related to all the topics of the curriculum development in the education course. The content of the course included the following topics: The basic concepts related to curriculum, such as types of curriculum, basics of curriculum development, need assessment (approaches and methods), goals and objectives of the curriculum, designing content, planning of instruction, and evaluation of the curriculum. Concerning the validity and reliability of final exam, 317 volunteer senior teacher candidates from various universities in Turkey (Manisa Celal Bayar, Ege, Çukurova, and Gazi Universities) participated. The final exam consisted of 22 multiple-choice questions and a matching type-three item question about the Curriculum Development Course which is consistent with the aims and goals of the Curriculum Development Course as established by the Higher Education Institution (2007). The mean item difficulty was 0.54, mean item discrimination was 0.40, and Kr-20 reliability coefficient was 0.71, according to the Test Analysis Program (TAP, version 14. 7. 4). As a result, the test can be considered valid and reliable.

"The Scale for Perception of Proficiency in Planning the Instruction" was developed by Gülbahar (2016). The scale was a 5-point Likert type and consisted of a single factor scale named "instructional planning proficiency". After conducting explanatory (with 313 teachers) and confirmative factor analysis (with 300 teachers), the internal consistency of the scale was found 0.97.

Data Analysis

In this study, to predict the achievement of teacher candidates in the Curriculum Development in Education Course, the Multiple Linear Regression (MLR) analysis was employed after checking the assumptions (Tabachnick & Fidell, 2007). In this study, normality, linearity, homoscedasticity, multicollinearity, and influential observations were checked to ensure no violation of the assumptions is present (Field, 2009; Tabachnick & Fidell, 2007). Also, to check for the existence of autocorrelation, the Durbin-Watson value was found to be 1.84 which is acceptable according to Field (2009). Data analyses were conducted using SPSS 22 and the significance of the alpha level was selected at the cut-off value of .05. Moreover, the reflections of teacher candidates on the discussion board were analyzed according to the number of reflections. In other words, teacher candidates' all meaningful messages including ideas were counted.

Results

In order to predict the achievement of teacher candidates in the Curriculum Development in Education Course, MLR was conducted. Firstly, descriptive statistics for the outcome variable, final grade, and predictor variables were shown in Table 3.

Table 3. Descriptive Statistics for the Final Scores and Predictor Variables

	M	SD
Final Grade	60.83	10.43
Lesson Plan Grade	82.65	10.91
Number of Reflections on the Discussion Board	10.24	6.94
Perception of Proficiency in Planning	3.60	.53

According to descriptive statistics shown in Table 3, teacher candidates obtained the mean score of *M*=60.83 (*SD*=10.43) from the final exam. Their lesson plan grades were higher than the final grade which is *M*=82.65 (*SD*=10.91). Moreover, the mean score of the number of reflections on the discussion board is *M*=10.24 (*SD*=6.94). Also, the mean score that teacher candidates obtained from the scale is *M*=3.60 (*SD*=.53). The mean score of the scale may indicate that their perception of proficiency in planning the instruction is above average.

Having presented the descriptive statistics, Pearson Correlation coefficients for the outcome and each predictor variable were computed. It was found that variables included in the study correlated among themselves significantly ranging from small to moderate correlations (Field, 2009). The correlations among variables were shown in Table 4.

Table 4. The Correlations among Final Scores and Predictor Variables

	(1)	(2)	(3)	(4)
Final Grade (1)	1			
Lesson Plan Grade (2)	.56**	1		
Number of Reflections on the Discussion Board (3)	.27**	.46**	1	
Perception of Proficiency in Planning (4)	.13	.22**	.11	1

***p*<.001

According to Table 4, the highest moderate correlation (*r*= .56) has been observed between the final grade and lesson plan grade variables. It can be said that when teacher candidates obtained higher grades from lesson plans they have prepared, the higher grades they obtained on the final exam. Moreover, the second moderately highest correlation (*r*= .46) was between the grades of teacher candidates obtained from the lesson plans they prepared and the number of reflections on the discussion board. In other words, as teacher candidates reflected more on the discussion board, and contributed to discussions about different course topics by participating more, they learned better about the parts of the lesson plan (objectives, content, teaching-learning, and evaluation parts) and obtained a higher lesson plan grade. Also, a small but significant correlation (*r*= .27) was found between the grades of teacher candidates obtained from the final exam and the number of reflections on the discussion board. It can be said that, as teacher candidates were active in both face-to-face and online parts of the course and reflected on their ideas more, they learned the course topics better and obtained a higher final grade. Furthermore, a small but significant correlation (*r*= .22) has been observed between the grades of teacher candidates obtained from the lesson plans they prepared and the score they obtained from the perception of proficiency in planning the instruction scale. It can be said that, as teacher candidates perceived themselves proficient in terms of preparing lesson plans, they prepared more efficient lesson plans (the parts of the plans are compatible with each other). For this reason, they obtain higher grades from their lesson plans.

Table 5. The Summary of the Multiple Linear Regression Analyses for Variables Predicting the Final Score

Variables	*B*	*SE B*	*β*	*t*	Sr^2	R^2	ΔR^2	ΔF
Model:						.31**	.31**	21.81**
Constant	16.66	6.88		2.42*				
Lesson Plan Grade	.53	.08	.55	6.91**	.48			
Number of Reflections	.03	.12	.02	.24	.01			
Perception of Proficiency in Planning	.11	1.39	.00	.08	.00			

*p < .01 **p < .001

The F-ratio for the model was $F(3, 143) = 21.81$ ($p < .001$), as shown in Table 5. In other words, the model was significant in predicting the final scores of teacher candidates. The lesson plan grades, number of reflections on the discussion board, and the scores obtained from the perception of proficiency in planning the instruction scale variables comprised the model and explained 31% of the variance in final scores. Moreover, the t-test statistics were checked to investigate the significant contribution of predictor variables to the model (Field, 2009), and as shown in Table 5, only the grades of the teacher candidates obtained from lesson plan $t(143)=2.42$, $p<.001$ significantly predicted the achievement of teacher candidates.

Discussion and Conclusion

In this study, it was found that the final grades of teacher candidates were correlated with their lesson plan grades, which are in line with previous literature (Li & Zou, 2017). In other words, as teacher candidates obtained higher grades on the lesson plans they prepared, the more they received higher grades from the final exam. Also, the grades of the teacher candidates obtained from lesson plans significantly predicted the final grades of teacher candidates. It can be inferred that as teacher candidates become sufficient in writing the parts of lesson plans, including objectives, content organization, teaching-learning strategies, methods, techniques, and evaluation parts which are in line with the objectives of the course, and they get higher grades on both their lesson plans and final exam since they have learned the topic better. Similarly, Asıroglu and Koc-Akran (2018) denoted that teaching practicum and lesson plans of low-performed teacher candidates revealed their acquisition of concepts related to teaching principles and methods at the knowledge level and the fact that they could not exemplify and practice teaching methods in real classroom contexts in their study including 224 sophomore teacher candidates at a foundation university. However, high-performing teacher candidates performed better in the design of instruction, and measurement and evaluation of objectives at different cognitive levels according to Bloom's taxonomy. Furthermore, Zafeiriou et al. (2001) found that familiarity with the subject had a positive effect on the participation levels of information studies students. Also, the research conducted by Kablan (2012), including 96 sophomore Elementary Teaching Mathematics Teaching teacher candidates, found that lesson plan preparation was affected more by theoretical learning, lesson plan applications, and concrete experiences. It may be inferred that as teacher candidates learned the subjects deeply, they contributed effectively to discussions, prepared better plans, and obtained higher grades in terms of both preparing lesson plans and final exam.

Moreover, it was found that the grades of teacher candidates obtained from the lesson plans they prepared and the final exam were correlated with the number of their reflections on the discussion board. In other words, as teacher candidates reflected more on the discussion board about their ideas and contributed to discussions about different course topics, they learned the parts of lesson planning (objectives, content, teaching-learning, and evaluation parts) better and obtained higher grades. Also, the feedback regarding teacher candidates' performance obtained from their peers and instructors might have encouraged participation in online discussions, which is in line with the literature (Branon and Essex, 2001; Sing & Khine, 2006), and contributed to the final exam as a critical variable. Also, teacher candidates might have thought about the topics longer before expressing them to peers, searched on the internet or course books, and learned different points of view from peers, which might have also contributed to their grades. Hrastinski (2007) revealed that the use of an online platform affected the participation of students positively since they wrote a higher number of sentences. Moreover, Fleming (2008) stated that students experienced greater cognitive learning when they exchanged between 80 and 100 messages, which was explained as far richer than the traditional classroom discussions. Chang (2008) discovered a close relationship between the performance of the online discussion and the achievement in project-based learning, which is similar to the current study. Online discussions, according to Zheng and Warschauer (2015), not only increased English learners' participation in classrooms but also contributed to gains in writing achievement. Additionally, students who participated more in the online discussion environment grew in their reading achievement during the school year. Ryan (2013) found that there was a significant difference in the level of student learning between the no-reflection group and the gain scores of small or large-threaded online discussion groups and the group which submitted written reflections to the instructor. It means that written reflections on the online discussion forums improve student achievement and

understanding. Moreover, Wei et al. (2015) discovered a direct relationship between education students' number of discussion board postings and their online learning performance (online-discussion scores, exam scores, and group-project scores) in an asynchronous online course from three Taiwanese universities. It can be inferred that as teacher candidates were active in the course and reflected their ideas on the discussion board, they learned the course topics better and obtained higher final grades.

Furthermore, a small but a significant correlation was found between the grades of teacher candidates obtained from the lesson plans they prepared and scores they obtained from the perception of proficiency on the planning scale. It can be said that, as teacher candidates perceived themselves as more proficient in terms of preparing lesson plans, they prepared more efficient lesson plans (the parts of the plans are compatible with each other). For this reason, they obtain higher grades from their lesson plans. Similarly, Yurtseven (2019) discovered that teacher candidates' perceived proficiency in instructional planning accounted for 56% of their achievement in instructional design. This means that perceived proficiency in instructional planning was a strong predictor of teacher candidates' achievement in instructional design. The results of some research also indicated that the planning levels of teacher candidates positively affected their ability to teach (Asıroglu & Koc-Akran, 2018; Kablan, 2012; Unver, 2002). For this reason, it is considered important that planning has a major place in the development of teachers' professional competencies.

All in all, it may be inferred that as teacher candidates contributed to online discussions effectively, they learned the subjects deeply, prepared better plans, and obtained higher grades in terms of both preparing lesson plans and final exam. It could be argued that, while a lesson or activity plan may not be a particularly accurate guide to what happens in the classroom, it does demonstrate 'intention to act.' Teacher candidates' lesson plans for a specific subject area may reveal information about their prior experiences and beliefs about planning.

Limitations and Recommendations for Future Studies

This study has certain limitations. The study was conducted at a state university located in the Aegean Region with a small sample size by including participants who were easy to access, which limited drawing generalizations that would apply for a broader population. For this reason, future studies may include more teacher candidates to generalize the findings. Although this study has some limitations, it presents the relations among class activities, lesson plan grade, and final exam, the findings may serve to show the importance of planning the instruction in teacher training in faculties of education.

As stated in the literature, planning the instruction processes progress in direct proportion to teachers' experience in their profession (Li & Zou, 2017; Orlich et al., 2010) and the application levels of teacher candidates depended on the number of lesson plans prepared (Davran, 2020). To produce effective teaching practices in their future professional career, teacher candidates should be provided with opportunities to practice planning the instruction in their sophomore Curriculum Development in Education course.

In the current study, quantitative data were collected through counting teacher candidates' number of reflections on the discussion board, assessing the outcomes through grades, and implementing a scale; however, reflection behavior of teacher candidates, the factors facilitating and limiting their reflections on the discussion board and the perceptions of teacher candidates about the contribution of the online part of the course to learning the course content and preparation of lesson plans might be investigated through interviews and observations.

Also, a small but significant correlation was found between the grades of teacher candidates obtained from the final exam and the number of reflections on the discussion board. This result might be affected by teacher candidates' willingness to learn, their familiarity with learning with technology, their priorities, and their existing workload. For this reason, it can be suggested that future studies might investigate the achievement of teacher candidates' by considering these kinds of situational and process variables.

In this study, teacher candidates were always in contact with their peers and course instructor both in face-to-face parts and outside of the class through a learning management system, which might have relieved the burden of learning and increased the involvement of teacher candidates since asking for help and obtaining support might have affected their grades. For this reason, it is suggested that teacher training courses might include a learning management system to support interactions between students and instructors.

Finally, in this study, teacher candidates took part in class and online activities asked questions, explained their opinions, reflected on the ideas of their peers, prepared sample lesson plans in groups, etc. Hence, it is suggested that teacher candidates should be provided with different active learning opportunities to apply what they have learned theoretically and increase their achievement.

References

Arends, R. L (2012). *Learning to Teach* (9th Ed.). McGraw-Hill

Asiroglu, S. & Koc-Akran, S. (2018). Öğretmen adaylarının ders planlarının ve öğretim uygulamalarının incelenmesi. [Examining of Preservice Teachers' Performance Preparing Lesson Plan] *E-Kafkas Eğitim Araştırmaları Dergisi*, *5*(3), 1-13. https://doi.org/10.30900/kafkasegt.442694

Atik-Kara, D. & Saglam, M. (2014). Öğretmenlik meslek bilgisi derslerinin öğrenme öğretme sürecine yönelik yeterliklerinin kazandirilmasi yönünden değerlendirilmesi [Evaluation of professional teaching knowledge courses in terms of competencies regarding the learning and teaching process]. *Eğitimde Nitel Araştırmalar Dergisi*, *2*(3), 28-86. https://doi.org/10.14689/issn.2148-2624.1.2c3s2m

Alzahrani, M. G. (2017). The effect of using online discussion forums on students' learning. *The Turkish Online Journal of Educational Technology*, *16*(1), 163-176.

Branon, R. F., & Essex, C. (2001). Synchronous and asynchronous communication tools in distance education. *TechTrends, 45(1), 36–36.* https://doi.org/10.1007/BF02763377

Bransford, J., Darling-Hammond, L. & LePage, P. (2005). Introduction. In Darling-Hammond, L. and Bransford, J. (Eds.), (p. 1-39). *Preparing teachers for a changing world: What teachers should learn and be able to do*. Jossey-Bass

Brooks, C. D. & Jeong, A. (2006). Effects of pre-structuring discussion threads on group interaction and group performance in computer-supported collaborative argumentation. *Distance Education, 27*(3), 371-390. https://doi.org/10.1080/01587910600940448

Caena, F. (2011). *Literature review. Teachers' core competencies: Requirements and developments. European commission.* Retrieved from https://ec.europa.eu/assets/eac/education/experts-groups/2011-2013/teacher/teacher-competences_en.pdf

Chang, C-C. (2008). A case study on the relationships between participation in online discussion and achievement of project work. *Journal of Educational Multimedia and Hypermedia, 17*(4), 477-509.

Cheung, W. S. & Hew, K. F. (2011). Design and evaluation of two blended learning approaches: Lessons learned. In Hong, K. S. & Lai, K. W. (Eds), ICT for accessible, effective and efficient higher education: Experiences of Southeast Asia. *Australasian Journal of Educational Technology*, 27(Special issue, 8), 1319-1337. https://doi.org/10.14742/ajet.896

Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education* (6th Ed.). Routledge.

Cook, S. & Germann, C. (2010). The tell-tale data: Virtual whispering and final student grades. Retrieved from: https://files.eric.ed.gov/fulltext/ED508149.pdf

Council of Chief State School Officers. (2013). Interstate teacher assessment and support consortium. *InTASC model core teaching standards and learning progressions for teachers 1.0: A Resource for ongoing teacher development.* Washington DC.

Çolak, E. & Yabaş, D. (2017). Öğretmen adaylarının ders planlarının yapılandırmacı yaklaşımı uygulamaya yönelik öz yeterlilik inanç düzeyleri açısından incelenmesi [Investigating Lesson Plans of Teacher Candidates according to their SelfEfficacy Levels towards Implementation of Constructivist Approach]. *İnönü University Journal of the Faculty of Education, 18*(2), 86-103. https://doi.org/10.17679/inuefd.323420

Davies, D., & Rogers, M. (2000). Pre-service primary teachers' planning for science and technology activities: Influences and constraints. *Research in Science & Technological Education, 18(2), 215–225.* https://doi.org/10.1080/713694980

Davran, A. M. (2020). *Eğitim fakültesi öğrencilerinin öğretmenlik uygulamasında ders planı hazırlama ve uygulama durumları [The situations of faculty of education students in lesson planning and practice within the teaching practicum course]* [Unpublished master's thesis]. Ankara University.

Demirel, Ö. (2017). *Öğretim ilke ve yöntemleri, öğretme sanatı [Principles and methods of instruction, the art of teaching]*. Pegem.

Dorgu, T. E. (2015). Different teaching methods: A panacea for effective curriculum implementation in the classroom. *International Journal of Secondary Education*, *3*(6-1), 77-87. https://doi.org/10.11648/j.ijsedu.s.2015030601.13

Ebrahimi, A., Faghih, E., & Marandi, S. S. (2016). Factors affecting pre-service teachers' participation in asynchronous discussion: The case of Iran. *Australasian Journal of Educational Technology, 32*(2), 115-129. https://doi.org/10.14742/ajet.2712

Erden, M. (2017). *Eğitim bilimlerine giriş [Introduction to educational sciences]*. (11th Ed.). Arkadaş.

European Commission. (2013). *Education and training. Supporting teacher competence development for better learning outcomes*. Retrieved from https://ec.europa.eu/education/policies/school/teaching-professions_en

Farrell, T. S. C. (2013). Reflecting on ESL teacher expertise: A case study. *System, 41*(4), 1070-1082. https://doi.org/10.1016/j.system.2013.10.014

Field, A. P. (2009). *Discovering statistics using spss*. (3th Ed.). SAGE Publications.

Fleming, D. L. (2008). Using best practices in online discussion and assessment to enhance collaborative learning. *College Teaching Methods & Styles Journal, 4*(10), 21-39. https://doi.org/10.19030/ctms.v4i10.5573

Fraenkel, J. R. & Wallen, N. E. (2009). *How to design and evaluate research in education* (7th ed.). New York: McGraw Hill.

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An introduction* (7th ed.). Boston: Allyn-Bacon.

Gülbahar, B. (2016). Öğretimi planlama yeterlik algısı ölçeğinin geliştirilmesi: Geçerlik ve güvenirlik çalışması [Developing the scale for perception of proficiency in instruction planning: Validity and reliability study]. *Ahi Evran Univercity, Kırşehir Faculty of Education Journal (JKEF),* 17(3), 699-715.

Hagger, H., & McIntyre, D. (2006). *Learning teaching from teachers: Realizing the potential of schoolbased teacher education.* Maidenhead: Open University Press.

Hew, K. F., & Cheung, W. S. (2003). Evaluating the participation and quality of thinking of pre-service teachers in an asynchronous online discussion environment: Part 1. *International Journal of Instructional Media, 30*(3), 247-262.

Hrastinski, S. (2007). *The potential of synchronous communication to enhance participation in online discussions.* ICIS 2007 Proceedings. Retrieved from http://aisel.aisnet.org/icis2007/80

Jonker, H., März, V., & Voogt, J. (2020). Curriculum flexibility in a blended curriculum. *Australasian Journal of Educational Technology, 36*(1), 68-84. https://doi.org/10.14742/ajet.4926

Kablan, Z. (2012). Öğretmen adaylarının ders planı hazırlama ve uygulama becerilerine bilişsel öğrenme ve somut yaşantı düzeylerinin etkisi [The effects of level of cognitive learning and concrete experience on teacher candidates' lesson planning and application skills]. *Education and Science, (37)*163, 239-253.

Karagoz, M., Ak-Başoğul, D. & Yücelşen, N. (2017). Türkçe Öğretmeni adaylarının ders planı hazırlamadaki yeterlikleri (Hasan Ali Yücel Eğitim Fakültesi örneği) [The proficiency of pre-service teachers of Turkish in preparing lesson plan (Hasan Ali Yucel Faculty of Education sample). *International Journal of Language Academy, 5*(7), 67-80. https://doi.org/10.18033/ijla.3777

Li, W., & Zou, W. (2017). A study of EFL teacher expertise in lesson planning. *Teaching and Teacher Education, 66*, 231–241. https://doi.org/10.1016/j.tate.2017.04.009

McDiarmid, G. W., & Clevenger-Bright M. (2008). Rethinking teacher capacity. In Cochran Smith, M., Feiman-Nemser, S. & Mc Intyre, D. (Eds.), *Handbook of research on teacher education. Enduring questions in changing contexts* (pp. 134-156). New York, Abingdon: Routledge/Taylor & Francis.

Ministry of National Education [MONE] (2005). Eğitim ve öğretim çalışmalarının plânlı yürütülmesine ilişkin yönergede değişiklik yapılmasına dair yönerge (603). *Tebliğler Dergisi, 68, 2575.Retrieved from* http://tebligler.meb.gov.tr/index.php/tuem-sayilar/viewcategory/69-2005

Ministry of National Education] [MONE] (2017). *Öğretmenlik mesleği genel yeterlikleri*. Öğretmen Yetiştirme ve Geliştirme Genel Müdürlüğü. Retrieved from http://oygm.meb.gov.tr/www/ogretmenlikmeslegi-genel-yeterlikleri/icerik/486

Oguz, A. (2009). İngilizce öğretmenliği öğretmen adaylarının ders planı hazırlamaya ilişkin görüşleri [Prospective English teachers' views about preparing lesson plan]. *Mustafa Kemal University Journal of Social Sciences Institute, 6*(11), 456-477.

Orlich, D. C., Harder, R. J., Callahan, R. C., Trevisan, M. S., & Brown, A. H. (2010). *Teaching strategies: A guide to effective instruction*. (9th Ed.). Boston, MA: Wadsworth Publishing.

Pelton, R. P. (2007). From performing to performance: Can the repositioning of teacher candidates create a measurable impact on children's achievement while developing positive teaching dispositions? In T. Townsend & R. Bates (Eds.), *Handbook of teacher education* (pp. 219-228). Dordrecht: Springer.

Ryan, R. S. (2013). *The effect of online discussion forums on student learning and student perception of learning in a science course at the community college level.* (Unpublished Dissertation). University of Southern Mississippi. Retrieved from https://aquila.usm.edu/dissertations/207/

Seethamraju, R. (2014). Effectiveness of using online discussion forum for case study analysis. *Education Research International*, 1–10. Retrieved from http://dx.doi.org/10.1155/2014/589860

Senemoğlu, N. (2015). *Gelişim, Öğrenme ve öğretim [Development, learning and teaching]*. (24. Baskı). Ankara: Yargı Yayınevi.

Sing, C. C., & Khine, M. S. (2006). An analysis of interaction and participation patterns in online community. *Educational Technology & Society, 9*(1), 250-261.

Song, L. & McNary, S. W. (2011). Understanding students' online interaction: Analysis of discussion board postings. *Journal of Interactive Online Learning, 10*(1), 1-14.

Sprinthall, N. A. & Sprinthall, R. C. (1990). *Educational psychology: A developmental approach*. New York: Mc Graw-Hill, Inc.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (6th Ed.). Boston: Pearson Education Inc.

Talbert, R. (2014). Inverting the linear algebra classroom. *Primus, 24*(5), 361-374. https://doi.org/10.1080/10511970.2014.883457

Tatar, N. & Ceyhan, N. (2018). Fen Bilgisi öğretmen adaylarının yapılandırmacı kurama dayalı öğretim uygulamalarının geliştirilmesi [Development of pre-service science teachers' constructivist-oriented teaching practices]. *Elementary Education Online*, *17*(1), 207-222. https://doi.org/ 10.17051/ilkonline.2018.413758

Toman, U. & Basaran, E. (2019). Öğretmen adaylarının öğretim becerileri üzerine bir inceleme [Analysis of teaching skills of pre-service teachers]. *Uluslararası Sosyal Araştırmalar Dergisi*, *12*(65), 881-891. https://doi.org/10.17719/jisr.2019.3501

Tsui, A. B. M. (2009). Distinctive qualities of expert teachers. *Teachers and Teaching, 15(4), 421–439.* https://doi.org/10.1080/13540600903057179

Unver, G. (2002). Okulöncesi eğitimi öğretmen adaylarının ders planı modelleri [Pre-school teacher traines' lesson plan models]. *Education and Science*, *27*(126), 62-69.

Wei, H. C., Peng, H., & Chou, C. (2015). Can more interactivity improve learning achievement in an online course? Effects of college students' perception and actual use of a course-management system on their learning achievement. *Computers & Education, 83*, 10-21. https://doi.org/10.1016/j.compedu.2014.12.013

Yurtseven, N. (2019, October 9-12). *The investigation of teacher candidates' proficiency in planning the instruction: Factors affecting the process.* 7th International Congress on Curriculum and Instruction (ICCI-EPOK) October 9-12, 2019 Ankara

Higher Education Institution (2007). *Öğretmen yetiştirme ve eğitim fakülteleri (1982-2007): Öğretmenin üniversitede yetiştirilmesinin değerlendirilmesi* [Teacher training and faculties of education (1982-2007): The evaluation of teacher training in university]. Ankara, Turkey: Author.

Zafeiriou, G., Nunes, J. M. B., & Ford, N. (2001). Using students' perceptions of participation in collaborative learning activities in the design of online learning environments. *Education for Information, 19*(2), 83–106. doi:10.3233/efi-2001-19201

Zheng, B., & Warschauer, M. (2015). Participation, interaction, and academic achievement in an online discussion environment. *Computers & Education, 84*, 78–89. https://doi.org/10.1016/j.compedu.2015.01.008

Appendix 1. Lesson Plan Grading Rubric

LEVELS					
5	**4**	**3**	**2**	**1**	**0**
• Objectives are written in accordance with objective writing criteria. • The content is explained clearly and aligned with the objectives. • The teaching technique is chosen in line with the course objectives. • The implementation of teaching activities is stated step by step. Which materials are selected and how to use them are explained. • At the end of the instruction, how the evaluation will be conducted, which measurement tools will be used or which questions will be asked are explained in detail.	• Objectives are written in accordance with the objective writing criteria, but there are some minor errors. • Content aligns with objectives but it is explained partially. • The teaching technique is compatible with the objectives, but more appropriate techniques can also be selected. • How teaching activities will be implemented is explained, which materials are selected are stated, but not explained. • At the end of the instruction, how the evaluation will be conducted is explained briefly.	• Some mistakes were made while writing objectives. • The content is compatible with the objectives, but it is explained very briefly in one or two sentences. • The teaching technique is compatible with some of the objectives. • How the teaching activities will be conducted is stated briefly, but which materials are selected and how they will be used are not explained. • The evaluation is stated only as a title without explaining how the students will be evaluated.	• Objectives are written in the lesson plan, but more than half do not meet the criteria for writing objectives. • The content is stated, but the explanations are not enough. • The teaching technique is not compatible with the objectives. • The explanations about how to implement the teaching activities are insufficient and which materials are selected and how they will be used are not explained. • How the students will be evaluated is not specified.	• The lesson plan is submitted, but only the headings are included in a sentence.	Lesson plan is not submitted.

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Using Popular Films in History of Mathematics Courses: Reflections from Prospective Mathematics Teachers

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Using Popular Films in History of Mathematics Courses: Reflections from Prospective Mathematics Teachers

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Abstract

This article examines the reflections of prospective mathematics teachers about the use of popular films in a history of mathematics course. Three films are used in the course are Agora, The Man Who Knew Infinity and A Beautiful Mind, describing mathematicians' experiences and struggles in different historical moments. Following the completion of the course, twelve prospective middle school mathematics teachers voluntarily participate in the face-to-face semi-structured interviews. According to the results, popular films are inspirational for prospective mathematics teachers to pursue further mathematical studies and the stories in the films are influential while making future decisions. For prospective mathematics teachers, popular films are also helpful to put mathematicians in context in which their life styles and experiences become more visible. Despite the benefits of watching mathematicians in the films, prospective mathematics teachers reflect on the fact that popular films are coming from a profit-driven sector and they reflect on how the commercial purposes can limit a full comprehension of mathematicians' lives. In the light of the findings, popular films are recommended as productive instructional materials in mathematics teacher education courses while there is a need to reflect on the commercial purposes and disadvantages.

Keywords: History of Mathematics, Mathematics Teacher Education, Mathematicians in History, Popular Films

Introduction

History of Mathematics [HoM] is gained an increased attention by mathematics teacher education research. HoM can provide various learning opportunities for prospective mathematics teachers [PMT] such as providing a historical background for mathematics, promoting PMTs' pedagogical reflection on mathematical concepts and improving their beliefs and attitudes towards teaching mathematics (Furinghetti, 2007). Experiencing the historical construction of mathematics can bring an awareness to the contextual aspects of doing mathematics (Fauvel, 1991) and can enable a consideration of mathematics as an evolving body of knowledge rather than irrefutable and eternal truths (Barbin, 2000). Therefore, several mathematics teacher education programs consider HoM as an elective or required course for prospective teachers in addition to content courses.

There are different purposes of using HoM in mathematics education (Jankvist, 2009). The first one is using HoM as a tool to develop teaching and learning mathematics. HoM as a tool can be considered as an instructional pedagogy for school mathematics. Second, HoM can also be the goal. HoM as a goal focuses on "the development of mathematics in a scientific, technological or societal context of a given time and place" (Jankvist, 2009, p. 252). In this study, HoM is not only considered as a pedagogical tool to improve mathematical knowledge or attitude but also as a goal for PMTs, since the primary focus of the course is to learn historical development of mathematical knowledge. In the sense of HoM-as-a-goal, mathematics history provides an avenue for PMTs to encounter the multiple ways of development of mathematical knowledge by showing mathematicians' actual struggles in approaching and solving the problems (Liu, 2003).

As argued in the HoM literature, visual aids can be one of the ways to learn mathematics history (Fauvel & van Maanen, 2000). Specifically, popular films have the potential to provide an avenue for prospective teachers to explore the struggles and actual experiences of mathematicians in different periods and locations as a way to study the humanistic facet of mathematics history and development of mathematical knowledge. Popular films might be counted as alternatives to the instructional strategies to teach mathematics history such as lecturing, reading or presenting the historical materials. Historical development of mathematical knowledge can be learned and studied through watching popular films that reflect experiences, struggles, and

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opportunities of mathematicians across the history. This paper examines the views of PMTs on the use of popular films as an alternative instructional material in a HoM course that is offered in a mathematics teacher education program in Turkey.

The studies that are relevant to HoM in mathematics teacher education generally focus on improving mathematical knowledge that prospective teachers are going to teach (Arcavi et al., 1987; Clark, 2012; Jankvist et al., 2020; Mersin & Durmuş, 2021), developing positive attitudes, motivation and beliefs towards mathematics (Furinghetti, 2007; Phillippou & Christou, 1998; Zengin, 2018), and providing instructional materials, pedagogical tools, and techniques for teaching mathematics (Jankvist, 2009). A meta-analysis of the HoM literature reveals that the empirical research in mathematics teacher education programs mainly investigates the reflections of PMTs in terms of using HoM as a pedagogical tool to improve their future mathematics teaching practices (Baki & Bütüner, 2018). The overarching trend of the research is that prospective teachers are generally show positive attitude towards using HoM when they become future mathematics teachers (Alpaslan et al., 2014; Dündar & Çakıroğlu, 2014, Sullivan, 2000; Yenilmez, 2011). This indicates that prospective teachers are open to learn HoM and to gain experience in the integration of it into their pedagogical repertoire to improve learning opportunities for their future students (Burns, 2010).

According to Fauvel and van Maanen (2000), there are several ways of using HoM in mathematics education to benefit from learning historical development of mathematical knowledge and they suggest a variety of ways of using HoM through historical anecdotes, primary sources, historical problems, play, and visual materials, including films. However, the review of empirical studies in the context of HoM indicates that small historical anecdotes and mathematical activities are the most commonly used instructional sources and there is a need to find alternative materials (Baki & Bütüner, 2018). To fill that void, popular films about mathematics history are used in the HoM course.

In the literature, one of the productive instructional tools in teacher education courses are popular films are considered as productive tools in teacher education programs, which can increase engagement and critical reflection about the topics of interest when connected conceptually to the content of the courses (Bluestone, 2000; Tan, 2006). For instance, education-themed films can allow prospective teachers to move into worlds of schooling and to analyze the contextual elements in educational situations (Fennell, 2013). Studies report that practicing or prospective teachers consider films are effective tools to concretize abstract historical ideas (Kaya & Günal, 2015), to explore the daily use of science and the role of families in learning science (Güven Yıldırım et al., 2015), and to learn Turkish as a second language by engaging with the dialogues, mimics and affective dimension of the conversations (İşcan & Karagöz, 2016). Similarly, in mathematics education, films can provide a space to encounter the life of mathematicians with attention to the cultural and historical context that they lived and worked in, rather than presenting static images of mathematicians.

Education-themed movies are well-known instructional materials in teacher education. Films are useful to increase academic motivation and develop positive attitudes towards teaching such as building love, value and harmony with students (Kontaş, 2016). In classroom management courses, movies are perceived as beneficial to represent practical situations in addition to the theoretical knowledge (Tofur, 2018). To explore advanced social concepts such as social and cultural habitus of a society, films are considered as bridges to connect theory and practice (Trier, 2002). Films can challenge prospective teachers' beliefs and values about teaching in schools that are different from their own environments by raising points of reflection about learning and teaching and issues in diverse educational communities (Grant, 2002).

Trier (2002) noted that watching popular films to analyze educational concepts or to engage with the content of the course is not without any resistance. That is, although using popular films in teacher education courses is a productive avenue to learn the content, prospective teachers can respond in negative ways when they have no interest in the film or the topic. Further, when films play on the prospective teachers' emotions, the film and its message can be misread. This might undermine the critical reflection that is aimed by the teacher educator (Giroux, 1993) and reproduce naïve beliefs about teaching in urban schools (Grant, 2002). Despite these potential pitfalls of using films, English and Steffy (1997) argued that through watching films, it becomes possible to observe nonverbal discourses such as body language, facial expressions and mimics. That is, films are considered as valuable teaching materials that provide contextual views of the issue that they address. When the content is explored through the life of a film character, it becomes more concrete and relevant to the students (Gregg et al., 1995). If appropriately chosen, films are useful instructional materials for the prospective teachers to reflect and think deeply on an issue (Tan, 2006).

Given the calls and cautions regarding the use of popular films in teacher education and the lack of related research in mathematics teacher education, it is significant to do additional research in different contexts and with different participants. Movies about mathematicians can provide opportunities for PMTs to enter the world of mathematics history. During the course, these three films, which are explained in detail in the methods

section of this article, are discussed as reflective of mathematicians' life stories, chances and barriers in various contexts and in different historical moments. Rather than presenting static images of mathematicians, films can provide a space to encounter with the life of mathematicians with an attention to the cultural and historical context that they did live and work.

The purpose of this article is to explore the reflections of prospective teachers about using popular films in a HoM course. As the review of teacher education literature indicates, films are considered useful materials in teacher education courses. However, there is a lack of research that examines the role of popular films in HoM courses. The empirical research on HoM in mathematics teacher education mainly focuses on the affective aspects on learning mathematics history or inclination to use mathematics history in future teaching (Furinghetti, 2007; Phillippou & Christou, 1998). Another line of HoM research focuses on the development of mathematical knowledge through learning mathematics history (Clark, 2019; Mersin & Durmuş, 2021). These studies rarely attend to the instructional tools to teach mathematics history. One exception is the use of GeoGebra in a HoM course, where prospective teachers report their conceptual learning of mathematics (Zengin, 2018). In addition to this, incorporating popular films into the HoM courses is considered as one of the ways of learning the historical development of mathematical knowledge together with mathematicians' experiences while pursuing their mathematical works. The reflections provided by PMTs give insights regarding how to teach HoM courses effectively in mathematics teacher education programs.

Given there is a scarcity of research that investigates the role of using popular movies in mathematics teacher education, this study aims to contribute to the HoM scholarship with its particular focus on the humanistic facets of doing mathematics in different historical settings: Following research question is asked:

- What are the views of prospective mathematics teachers about using popular films about the life of mathematicians in history of mathematics courses?

Method

Research Design

To respond to the research question of this paper, case study design was used. The fundamental goal of case study research was to explore how people interpret and make sense of their experiences in a bounded environment (Creswell, 2013). It provided both descriptive and interpretive accounts on how people reflect on an issue or a course of action. Since the aim of this paper was to examine the reflections of PMTs about using popular films in the HoM course and it studies shared experiences of multiple individuals for a particular program, case study was chosen as a suitable design, which thematically uncovered how individuals make meaning of an issue based on their perspectives.

Participants and Context

Participants were 12 prospective mathematics teachers [PMTs] who completed an elective history of mathematics course at a large public research university in Turkey. There were nine females and three males. All participants were in mathematics education degree program for middle schools at bachelor's level. Five of them were in their third year and seven of them in the fourth year. Their ages ranged between 20 and 22. Purposive sampling method was used. The criterion for selecting the participants is the completion of HoM course and its requirements. The reason for choosing these PMTs was that they took this elective HoM course, watched the target films as their course requirements, and volunteered to participate in the study.

History of Mathematics Course and the Selection of Popular Films

The content of HoM course included the mathematical knowledge from Ancient Egypt, Ancient Greeks, Mesopotamia, India and Far East countries as well as the works of mathematicians from the Islamic world such as Al-Khwarizmi and Khayyam among others and their impact on the development of Modern Mathematics. The aim of the course is determined as learning the historical development of mathematical concepts across different periods and locations (Higher Education Council [HEC], 2007).

To explore the contextual elements in the life of mathematicians and the humanistic aspects of mathematical knowledge construction processes, three popular films were used as an instructional material. The movies were *Agora*, directed by Alejandro Amenábar (Bovaira & Augustin, 2009), *The Man Who Knew Infinity*, directed by Matthew Brown (Pressman et al., 2015) and *A Beautiful Mind*, directed by Ron Howard (Grazer & Howard, 2001). Agora narrated the life of Hypatia, a woman mathematician, astronomer and philosopher in the fourth century East Roman Empire. The movie focused on the struggles of Hypatia as a woman and her dedication to contribute mathematical knowledge. The Man Who Knew Infinity described the life of an Indian mathematician Srinivasa Ramanujan and his travel to Cambridge University. His mathematical successes despite the social and cultural challenges he faced in the university were portrayed in the film. A Beautiful Mind

was based on the life of an American mathematician, John Nash, who was having difficulties to distinguish between the reality and the fiction and who was also the winner of the Nobel Prize for his unpredictable work on game theory. The story in the film was built upon his struggles both as a mathematician trying to do novel work and as a one who was experiencing mental difficulties.

These three films were selected due to the in depth portrayal of mathematicians' lives, their experiences and challenges in different historical contexts. There are certainly other films that could be related to mathematics history. Popularity is referred as being the product of popular culture. The chosen films did not have to be well-known or top-rated movies. Rather, popularity indicated the wide range of availability and suited to the taste of the general public. These three films were chosen for their portrayal of mathematicians' lives, their experiences, and challenges in different historical contexts.

As suggested by Demircioğlu (2007), worksheets were distributed prior to watching films. In these worksheets, a set of prompt questions was provided for PMTs so that they could focus on the social and situational aspects of mathematical developments of the given historical period. *The examples of these questions are: What were the advantages and disadvantages of Hypatia being a woman while doing math? Evaluate Ramanujan's experiences during his visit to England in terms of his cultural identity. What were John Nash's observations, thoughts and questions as developing his theorem, known as the "Nash equilibrium" in the movie?* Following PMTs watched movies, they were asked to answer the prompt questions, reflect upon the life of the mathematicians as part of the course requirement. One course session was also devised to discuss the issues that PMTs raised about the movies. Since PMTs were assigned to watch three popular films as described above, all in all, three course sessions were allocated for the discussion of the popular films. Nevertheless, PMTs' responses to the questions and discussion sessions were part of the course itself. That is why; these were not included in this study due to ethical considerations.

Data Collection and Analysis

The data of this study was collected through the face-to-face interviews that were conducted with PMTs following they completed the HoM course. Interviews lasted on average 30 minutes, ranging between 25 to 45 minutes. All interviews were audiotaped and then transcribed. The interview questions included how PMTs made meaning of popular films that were about different mathematicians. Further, during these interview sessions, the experiences of mathematicians as humans were unpacked by asking specific questions about the storylines of mathematicians in the films. The overall aim of interviews was to understand how PMTs reflected on the use of popular films in their HoM course. Sample interview questions included: *What are the advantages and disadvantages of watching popular films in HoM courses? How do you think about using popular films in HoM courses? How do popular films help you to learn about mathematics history and the lives of mathematicians?*

Each interview was transcribed verbatim. In basic qualitative research, data analysis consisted of identification of the recurring patterns and themes (Merriam, 2009). In order to find those recurring themes, inductive methods were used for data analysis (Corbin & Strauss, 2008). As the use of popular movies in HoM courses was very rare in the literature, the participants' own words and statements were used to develop codes through open coding (Saldaña, 2013). When deciding the parts of transcripts to code, the analytic focus was given on the instances that PMTs talked about the contextual elements of mathematicians' biographies, advantages and disadvantages of using movies in HoM courses. The coding process gave an initial list of codes such as "inspirational", "struggling as a woman" and "profit-driven industry". Following the coding of each interview, the data were further reviewed to refine codes. Initial codes and corresponding passages were analyzed to generate umbrella themes using constant comparison method (Corbin & Strauss, 2008). For example, initial codes based on participants' own words such as "social and cultural conditions of mathematicians", "cultural difficulties experienced while conducting mathematical work" and "struggling as a woman" were brought together under the umbrella theme, "putting mathematicians in context". These themes were presented in the findings section. To ensure the credibility of the findings, rich descriptive accounts of PMTs were provided. Before presenting the results, coded passages of PMTs were translated into English by the author of this article. PMTs' reflections on the use of popular films were narrated in the themes presented in the findings section.

Results

The purpose of this research was to investigate PMTs' reflections on the use of popular films in HoM courses. According to the analysis, their opinions were concentrated around four main themes. First, popular films were seen as inspirational for doing mathematics and influential in making future decisions. Second, for PMTs, films were helpful materials to put mathematicians in context and to learn the social circumstances of the time. Third, PMTs reflected on the advantages and disadvantages of the use of popular films as an instructional material.

Last, PMTs also identified the possible dangers of the film industry and the limitations of movie plot to learn mathematics history. Each of the findings is presented below with quotations from PMTs under the following themes.

Popular Films as Inspirational for Doing Mathematics

The first theme that emerged from the reflections of PMTs was the perception of the popular films as inspirational for doing and pursuing mathematical work. According to them, the films were stimulating their attention towards the cumulative development of mathematical knowledge, which required an effort. As PMT3 commented:

> *All of the films inspired me, not just mathematics but I again remembered that if I try to do something in any situation, I have to struggle to overcome it. Success is not easy. After every movie, I realized that nothing is easy to obtain. And, in order to do mathematics even one needs to refute the theorems, it is necessary to proceed in cumulatively, based on the theorems in the past (PMT3).*

Despite the obstacles that mathematicians face throughout their life, their successes in mathematics were encouraging. Mathematicians' works in the films were understood by the PMTs in a broader sense such as doing mathematics and contributing mathematical knowledge base. Films inspired PMTs about the perseverance of mathematicians who never gave up working, solving mathematical problems of their time and conducting mathematical research. Below, PMT5 expressed how the movie was effective for them to see that mathematicians in the films never gave up:

> *They [mathematicians] went through a lot thing, but still didn't give up. For example, I would give up. There were many occasions in the films where I thought I could give up. They never gave up. If I were Ramanujan, I would say if my health is getting worse and I would leave. If I were like the one in A Beautiful Mind, I would also leave mentioning my mental issues. I could not overcome it. It really impressed me that they didn't give up. It is very nice not to give up (PMT5).*

The perseverance of mathematicians was influential for PMTs in terms of their own mathematics courses as well as their foregrounding of future mathematics teaching. As PMT5 continued and PMT7 added:

> *I love watching movies anyway. When they are about mathematics and so, they are more interesting for me, I watched the movies with pleasure and wrote my thoughts in full [in the assignments]. As I watched the lives of scientists, my ambition in classes increased and I decided to do as best as I could do for my students in teaching mathematics (PMT5).*

> *The movies impressed me very much. The hero of each movie has a distinct adventure, a distinct struggle. Their goals were common, that was to work for the development in science (PMT7).*

PMTs reflections reveal the appreciation of the work of mathematicians and even as examples of hard work and perseverance. In addition to learning about the life of the mathematicians in different historical moments, PMTs reflected on the ways in which popular films contributed to their personal lives and decisions for future.

Popular Films as Putting Mathematicians in Context

PMTs generally expressed that popular films were helpful to understand the social and cultural circumstances of the time. PMTs were able to put mathematicians in context and they understood the works of mathematicians as inclusive of both mathematics itself and also their living conditions. Below quotations reveal how PMTs described mathematicians' living conditions in detail:

> *The greatest common feature of the mathematicians in the films is that they took big steps for mathematics as they dealt with social, religious, and health-related problems during the period they lived. If we look in detail, they are all faced with the prejudices such as Hypatia being a woman, Ramanujan being an Indian, John Nash being an introvert. At first glance, other people think that they cannot do anything for science and so these people do not help their work (PMT3).*

> *Also, it was good for me to evaluate the historical conditions of the periods where mathematics was developed (PMT10).*

> *Hypatia stood firm against war, religious complexities, and the male scientists of the time. She did not give up her purpose. Ramanujan also tried and succeeded in doing science in an environment where religion and racial discrimination were made. John Nash was not defeated despite the games his own brain played on him, and he struggled hard to complete his work (PMT3).*

Furthermore, popular films about mathematicians enabled PMTs to understand humanistic aspects of mathematical knowledge construction in diverse situations. PMTs commented on the experiences and difficulties of mathematicians while they were doing and contributing to mathematics in the following excerpts.

> *For example, when we watch the movies, Hypatia is really in a very difficult situation within their social and cultural environment. It was an unforgettable thing. In their perspective, there was a mandatory female profile that society imposed on her. And there were situations such as not being able to do it and move forward. But despite that, she was able to succeed (PMT9).*

> *He [Ramanujan] had to go to another country from his homeland. Although his family did not want it, he still went and continued his studies there (PMT8).*

For PMTs, using popular films was valuable to unpack mathematicians' struggles and challenges that they faced. After watching the movies, PMTs were able to empathize with the mathematicians and think about their mathematical success together with their social identities such as being a woman or an Indian. Several PMTs commented on the racial and gendered identities of mathematicians as they were in the process of mathematical knowledge development.

> *After watching the movie, for example… my view of women mathematicians… or I learned that they too can achieve a lot of success or they might have obstacles for different reasons (PMT2).*

> *I think the films were very valuable, as they allowed us to observe the lives, difficulties, ways of thinking and efforts of many mathematicians such as Ramanujan and Hypatia. As a prospective mathematics teacher, I think it enables us to live and think like a mathematician, or to be able to put ourselves in their place (PMT9).*

> *Again, they deal with many difficulties. Especially for Hypatia, for example, it is thought that the only job of women at that time was being a housewife, having children and cleaning the house. For example, she was treated as if ungodly because she was dealing with it [mathematics]. But she continued to work without paying attention to any such things, she was working day and night. She finally achieved the success she wanted. In addition, Ramanujan also left his family back and went to work (PMT11).*

Here, it is important to note that films compared to other tools to learn mathematics history seemed to be more influential for PMTs, particularly because they provided the situated narratives for the mathematical knowledge making processes. The visual narratives were important vehicles to put the life of mathematicians in the history in context.

Popular Films as Instructional Materials to Learn Mathematics History

PMTs mentioned the advantages of using popular films as an instructional material in HoM courses. For them, in general, watching popular films was an effective method of teaching and learning mathematics history, as the movies were interesting, stimulating and beneficial for meaningful understanding. PMT5 and PMT10 expressed their interest in not only watching for themselves but also using the films for their future students when they become mathematics teachers:

> *I definitely think that popular films need to be part of the mathematics history course. If there is a movie suitable for me, if I have time in my school when I become a teacher, I consider using movies. Because in movies you know a lot… it may be because I like it very much, but I also think that it contributed a lot, understanding the general view of those scientists (PMT5).*

> *First, I can easily attract my students to the class. They [students] become curious. Numerical operations usually do not catch the attentions of students. That… talking about those narrative parts… would probably attract my future students (PMT10).*

Furthermore, PMTs compared the use of popular movies with the other approaches such as reading a book or listening to a presentation. PMTs found watching movies was more beneficial for them to learn mathematics history and biographies of mathematicians. Below excerpts indicated how popular films were productive materials for them to learn mathematics history as opposed to other means:

> *Movies are for me, I never forget when I watch them, I always remember. But if we gave presentations, I would really forget [the content] after the presentation. The movie is a little more visual… the presentation is also visual... but the movie appeals more to our feelings. There is a connection. We give something in the presentation, then we pass, we cannot make a connection (PMT5).*

After all, we could read and learn this information from the book, but we try to understand it both by watching and hearing in the film. At least, it is more permanent and I think it is good with respect to getting our attention (PMT8).

I can say that it is more permanent by watching such movies rather than reading the life story by searching it (PMT9).

Besides the advantages, PMTs also mentioned the disadvantages of using popular films as an instructional material. Foregrounding with their future teaching, PMTs were cautious about movies that could be misread by the audience and be frightening for children. These two PMTs in the following quotations highlighted the ways in which popular films might have limitations for their future students.

Some parts were difficult even for me to understand. This may confuse my students (PMT3).

Here are the disadvantages. For example, if I tell the life of Ramanujan to students, they will probably see that a mathematician has not actually made a success in easy ways. So, it might sound a little scary to them (PMT10).

To summarize, PMTs generally think that using popular films in HoM course is an effective and productive instructional source that stimulates their interest in the lives of mathematicians and their knowledge about the contextual elements in mathematicians' lives. Nevertheless, PMTs note that using popular films can be inadequate for especially young age individuals.

Dangers of Film Industry

PMTs reflected on the film industry while expressing their views about the use of popular films in HOM courses. They were aware of the fact that popular films are the objects of a commercial sector. Also, selection of mathematicians for the films could be made in terms of its profit for the sector. PMT1 and PMT10 explained the dangers of commercial purposes in detail:

In order to make the movie, these people need to make money in the industry. They want to make money from the movie. They do not really want to publicize their [mathematicians] lives. This is a little bit troubling... There are perhaps much bigger mathematicians whose lives should be publicly visible (PMT1).

For example, Pythagoras has also achieved great success in the field of mathematics, but considering that the film was made for commercial purposes, the difficulties Pythagoras faced in his life may not be interesting enough for the audience and not worth watching. For this reason, producers may want to focus on the lives of people they think will make them a lot of money (PMT10).

In addition to PMTs' views about the popular films as originated in a commercial business, they mentioned the movie plots as dramatizing the biographies of mathematicians in order to catch the attention of the audience and to increase the profits. Some of their reflections on this issue are presented below:

For those who have a movie… the film needs a story. Yes, after all, watching the life of a regular person does not give anyone pleasure. All of them [mathematicians in the films] had difficulties in general. Their lives were not progressing easily by saying "look, I found a theory, oh I accepted it too". There was war, there was a disease, there were religious differences in the life of Hypatia, there were riots related to this and so on (PMT3).

The mathematicians whose films we watch are usually those who have encountered situations that would prevent and restrict them from doing mathematics and still continue to do mathematics without giving up and have achieved great success in the field of mathematics (PMT10).

The reason they are famous is that they have sad stories rather than theories. That's why these people are getting popular. Otherwise, although Cahit Arf is much more successful than them, many people do not even know the name of Cahit Arf. It has to have a sad story. You know ... The film industry should be able to sell that story (PMT1).

These quotes from PMTs indicate that they are aware of the fact that popular films are part of a profit-driven industry, which limits the issues of accuracy for the sake of commercial interests. Instead of unconscious watching of the life of mathematicians in the history as represented by the film producers, PMTs did also exhibit a critical eye on the movies.

Discussion and Conclusion

This study explores the reflections expressed by PMTs about the use of popular films in mathematics history courses. In the HoM course where PMTs watch popular films as part of the requirements, they gain the chance

to learn about the obstacles and opportunities that mathematicians experience in different historical moments. PMTs are generally inspired by the perseverance and hard work of the mathematicians who play in the movies. Popular films serve as an effective instructional tool for PMTs to learn HoM as a goal rather than as a tool to improve mathematics teaching and learning (Jankvist, 2009). Through popular films, PMTs become involved with the humanistic side of doing mathematics as they engage with the life of mathematicians more closely and they are inspired by the particular characteristics as role models. As Fried (2001) notes, one of the reasons for integrating the HoM into mathematics education is providing historical role models for students. Similarly, PMTs consider the mathematicians in the popular films as role models for themselves, especially when they mention their future decisions such as studying mathematics further or doing the best despite the hard conditions of life. In this sense, a popular film can be used to develop a historical awareness of mathematics and the socio-cultural context in which mathematics has been developed (Tzanakis & Arcavi, 2000). These indicate that using popular films about mathematicians is a way to learn the contextual aspects of the historical development of mathematical knowledge.

When HoM attends to the work of mathematicians in the construction of mathematical knowledge, one can recognize the work of others, respect and value different contexts, needs, and purposes, and realize the contribution of each civilization to the field of mathematics (Grugnetti & Rogers, 2000). In this regard, popular films are seen as helpful and effective instruments to learn the social and cultural context in which mathematicians work (Fauvel & van Maanen, 2000) and according to the findings of this study, PMTs seem to agree with this. For PMTs, the minute details as presented in the movies unpack the historical conditions that mathematicians experience. This enables PMTs to recognize the success of mathematicians together with their social identities such as being a woman or an Indian. In contrast to the images of mathematics as cold, abstract and value-free, movies help PMTs to focus on historical development of mathematical knowledge, as negotiated with social and cultural identities of mathematicians. That is, watching popular films of mathematicians who have diverse racial and gendered identities expands PMTs' conceptions of mathematical work together with social circumstances. This expansion can potentially enable an affirmation of social identities and the intricate relationship with doing mathematics.

For PMTs, popular films are productive instructional materials to learn mathematics history. With the help of the movies, they learn about how mathematicians contribute to the body of mathematical knowledge. Through movies, mathematicians' experiences and dynamic ways of reasoning together with their social context are emphasized. Popular films about mathematics history can reveal the actual struggles of human beings in diverse contexts while solving and engaging with mathematical problems. Hence, through the help of the popular films about mathematicians, PMTs conceives the dynamic processes of mathematical knowledge development (Grugnetti & Rogers, 2000).

Further, PMTs compare watching popular films with other instructional approaches in the HoM course. Similar to what is generally found in the literature (English & Steffy, 1997; Kontaş, 2016; Tofur, 2018), PMTs consider popular films are more advantageous for visualizing and narrating the context. Specifically, they have the opportunity to watch mathematicians as actual people as well as their feelings and struggles in solving the problems. As they argue, films as providing long-lasting learning opportunities than the other instructional tools in the HoM course such as presentations of historical periods or reading books about mathematics history.

PMTs also express the use of popular films in their future mathematics teaching. Despite the benefits, PMTs mention that popular films might not be suitable for school-age children. Their tensions are mainly built on their assumptions that the movies could be misread or frightening due to their story plot and contexts consisting of wars, social conflicts and illnesses. Further research is needed to examine the use of popular films in school mathematics and how experienced teachers perceive the suitability of using popular films in mathematics classes for children.

Given these merits of learning historical development of mathematical knowledge and contextual aspect of the mathematicians' lives, PMTs of this study do not watch the films without any critical thought. In the interviews, they comment on the fact that popular films are made in a profit-based industry. Similarly, Kaya and Günal (2015) find that history teachers are also critical about the rating concerns of historical TV series while teaching history. As commercial products, these materials can overwhelmingly dramatize the story or portray a deficient view of the history by only focusing on dramatic stories to gain more audience and so, more profit can be made. Hence, when using popular films or series in teacher education courses, it is important to reflect on how the stories are fictionalized and dramatized for commercial purposes.

As an implication of this study, popular films can be recommended as one of the ways to open up the conversation about who the mathematicians are and how they develop mathematical knowledge in different times and spaces. When used with supportive educational activities, mathematics teacher educators are

encouraged to use popular movies in their mathematics history courses in order to provide contextual insight into the social and cultural aspects of the historical development of mathematical knowledge.

Having said the implications, it is important to note that this study is limited to the participants, the HoM course, and the three films that are used as an instructional material. Therefore, the conclusions above are bounded with this particular study. Further research is needed to explore the use of popular films in HoM and other teacher education courses with additional movies.

References

Alpaslan, M., Işıksal, M., & Haser, Ç. (2014). Pre-service mathematics teachers' knowledge of history of mathematics and their attitudes and beliefs towards using history of mathematics in mathematics education. *Science & Education*, *23*(1), 159-183. https://doi.org/10.1007/s11191-013-9650-1

Arcavi, A., Bruckheimer, M., & Ben-Zvi, R. (1987). History of mathematics for teachers: The case of irrational numbers. *For the Learning of Mathematics, 7*(2), 18-23. https://www.jstor.org/stable/40247891

Baki, A., & Bütüner, S. O. (2018). A meta-synthesis of the studies using history of mathematics in mathematics education. *Hacettepe University Journal of Education, 33*(4), 824-845. https://doi.org/10.16986/huje.2018036911

Barbin, E. (2000). Integrating history: Research perspectives. In J. Fauvel & J. Van Manen (Eds.), *History in mathematics education—The ICMI study* (pp. 63-90). Kluwer Academic.

Bluestone, C. (2000). Feature films as a teaching tool. *College Teaching 48*(4), 141-146.

Bovaira, F. & Augustin, A. (Producers) & Amenábar, A. (Director). (2009). *Agora* [Motion Picture]. Focus Features.

Burns, B. A. (2010). Pre-service teachers' exposure to using the history of mathematics to enhance their teaching of high school mathematics. *Issues in the Undergraduate Mathematics Preparation of School Teachers, 4*, 1-9.

Clark, K. (2012). History of mathematics: Illuminating understanding of school mathematics concepts for prospective mathematics teachers. *Educational Studies in Mathematics, 81*(1), 67–84. https://doi.org/10.1007/s10649-011-9361-y

Clark, K. (2019). History and pedagogy of mathematics in mathematics education: History of the field, the potential of current examples, and directions for the future. In U. T. Jankvist, M. Heuvel-Panhuizen, & M. Veldhuis (Eds.), *Eleventh Congress of the European Society for Research in Mathematics Education* (pp. 29–55). Utrecht University.

Corbin, J., & Strauss, A. L. (2008). *Basics of qualitative research.* Sage.

Creswell, J. W. (2013). *Qualitative inquiry & research design: Choosing among five approaches* (3rd edition). Sage Publications

Demircioğlu, İ. H. (2007). Tarih öğretiminde filmlerin yeri ve önemi [The place and importance of films in history teaching]. *Bilig, 42*, 77-93.

Dündar, S., & Çakıroğlu, M. (2014). Why should the mathematics history be used in mathematics education, *Eğitimde Kuram ve Uygulama*, *10*(2), 522-534. https://dergipark.org.tr/en/pub/eku/issue/5460/74069

English, F., & Steffy, B. (1997). Using film to teach leadership in educational administration. *Educational Administration Quarterly*, *33*(1), 107–115. https://doi.org/10.1177/0013161X97033001006

Fauvel, J. (1991). Using history in mathematics education. *For the Learning of Mathematics, 11*(2), 3-6. https://www.jstor.org/stable/40248010

Fauvel, J., & van Maanen, J. (Eds.). (2000). *History in mathematics education—The ICMI study*. Kluwer Academic.

Fennell, H. (2013). Reel stories of teaching: Film and teacher education. *Action in Teacher Education, 35*(5-6), 445-461. https://doi.org/10.1080/01626620.2013.846762

Fried, M. (2001). Can mathematics education and history of mathematics coexist? *Science & Education, 10*, 391–408. https://doi.org/10.1023/A:1011205014608

Furinghetti, F. (2007). Teacher education through the history of mathematics. *Educational Studies in Mathematics*, *66*(2), 131–143. https://doi.org/10.1007/s10649-006-9070-0

Giroux, H. A. (1993). Reclaiming the social: Pedagogy, resistance, and politics in celluloid culture. *Counterpoints*, *1*, 35-58. https://www.jstor.org/stable/45136431

Grant, P. A. (2002). Using popular films to challenge preservice teachers' beliefs about teaching in urban schools. *Urban Education*, *37*(1), 77-95. https://doi.org/10.1177/0042085902371006

Grazer, B. & Howard, R. (Producers) & Howard, R. (Director). (2001). *A beautiful mind* [Motion Picture]. Universal Pictures.

Gregg, V., Hosley, C., Weng, A., & Montemayor, R. (1995, March). *Using feature film to promote active learning in the college classroom.* Presented at the 9th Annual Conference on Undergraduate Teaching of Psychology: Ideas and Innovations. (Eric Document 389 367).

Grugnetti, L. & Rogers, L. (2000). Philosophical, multicultural and interdisciplinary issues, in J. Favuel & J. Van Manen (Eds.), *History in mathematics education—The ICMI study*, (pp. 39-62), Kluwer Academic.

Güven Yıldırım, E., Köklükaya, A., & Selvi, M. (2015). Öğretim materyali olarak 3-Idiot filmi ile öğretmen adaylarının günlük hayatta fenin kullanımı ve eğitimde aile rolü üzerine görüşlerinin belirlenmesi [Determination of candidate teachers' opinions on science in everyday life and family role in process of education with 3-Idiots movie as a teaching material]. *Trakya Üniversitesi Eğitim Fakültesi Dergisi*, *5*(2), 94-105. https://dergipark.org.tr/en/pub/trkefd/issue/21482/230219

Higher Education Council. (2007). *Eğitim fakültesi öğretmen yetiştirme lisans programları [Education faculty teacher preparation bachelor's programs]*. Retrieved from https://www.yok.gov.tr/Documents/Yayinlar/Yayinlarimiz/egitim-fakultesi-ogretmen-yetistirme-lisans-programlari.pdf

Jankvist, U. T. (2009). A categorization of the ''whys'' and ''hows'' of using history in mathematics education. *Educational Studies in Mathematics*, *71*(3), 235–261. https://doi.org/10.1007/s10649-008-9174-9

Jankvist, U. T., Clark, K. M., & Mosvold, R. (2020). Developing mathematical knowledge for teaching teachers: potentials of history of mathematics in teacher educator training. *Journal of Mathematics Teacher Education*, *23*(3), 311-332. https://doi.org/10.1007/s10857-018-09424-x

İşcan, A., & Karagöz, B. (2016). Yabancı dil olarak Türkçe öğretiminde konuşma becerisi kazandırmada filmlerin kullanımı. [The use of films to help students gain speaking ability in teaching Turkish as a foreign language]. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *20*(4), 1265-1278. https://dergipark.org.tr/en/pub/ataunisosbil/issue/26966/283397

Kaya, R., & Günal, H. (2015). Tarih öğretmenlerinin muhteşem yüzyıl dizisi özelinde tarih konulu film ve dizilerin öğretimde kullanımına yönelik görüşleri [Views of history teachers on the use of history-themed movies and TV series in teaching in the context of The Magnificent Century]. *Türk Tarih Eğitimi Dergisi*, *4*(1), 1-48. https://doi.org/10.17497/tuhed.185614

Kontaş, H. (2016). The effect of an education-themed movie on the academic motivation of teacher candidates and their attitude towards teaching profession. *Journal of Education and Training Studies*, *4*(6), 93-103. https://doi.org/10.11114/jets.v4i6.1483

Liu, P. (2003). Do teachers' need to incorporate the history of mathematics in their teaching? *Mathematics Teacher*, 96(6), 416-421.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation, (3rd edition)*. Josey-Bass.

Mersin, N., & Durmus, S. (2021). Effects of the enriched history of mathematics course on prospective mathematics teachers. *International Journal of Curriculum and Instruction*, *13*(1), 635-668.

Philippou, G. N., & Christou, C. (1998). The effects of a preparatory mathematics program in changing prospective teachers' attitudes towards mathematics. *Educational Studies in Mathematics*, *35*, 189–206. https://doi.org/10.1023/A:1003030211453

Pressman, E. R., Young, J., & Thomas, J. (Producers) & Brown, M. (Director). (2016). *The man who knew infinity* [Motion Picture]. Warner Bros.

Sullivan, K. M. (2000). *Pre-service secondary mathematics teachers' attitudes about the history of mathematics* (Order No. 1399933). Available from ProQuest Dissertations & Theses Global. (230757606).

Tan, C. (2006). Philosophical reflections from the silver screen: Using films to promote reflection in pre-service teachers. *Reflective Practice, 7*(4), 483-497. https://doi.org/10.1080/14623940600987080

Tofur, S. (2018). Use of educational movies in classroom management courses: A metaphorical study. *Turkish Online Journal of Qualitative Inquiry, 9*(4), 389-411. https://doi.org/10.17569/tojqi.423738

Trier, J. (2002). Exploring the concept of 'habitus' with preservice teachers through the use of popular school films. *Interchange, 33*(3), 237-260. https://doi.org/10.1023/A:1020941318001

Tzanakis, C., & Arcavi, A. (2000). Integrating history of mathematics in the classroom: An analytic survey. In J. Fauvel, & J. van Maanen (Eds.), *History in mathematics education, The ICMI Study* (pp. 201–240). Kluwer Academic.

Yenilmez, K. (2011). Matematik öğretmeni adaylarının matematik tarihi dersine ilişkin düşünceleri [Views of prospective mathematics teachers about history of mathematics course]. *Pamukkale University Education Faculty Journal, 30*, 79-90. https://dergipark.org.tr/en/pub/pauefd/issue/11113/132873

Zengin, Y. (2018). Incorporating the dynamic mathematics software GeoGebra into a history of mathematics course. *International Journal of Mathematical Education in Science and Technology, 49*(7), 1083-1098. https://doi.org/10.1080/0020739X.2018.1431850

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Investigation of Factors Predicting Job Satisfaction of School Counsellors in Turkey

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Investigation of Factors Predicting Job Satisfaction of School Counsellors in Turkey

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Abstract

Job satisfaction can be defined as individuals' perceptions of satisfaction towards their profession. This concept is also considered to be important for the school counselling profession because school counsellors' high level of job satisfaction is assumed to have positive effects not only on them but also on their students and accordingly on the education system. Therefore, it is thought that it is important to examine the factors that predict job satisfaction of school counsellors. For this purpose, this study was conducted on 194 (female=145 and male=49) school counsellors in Turkey. As a result of the research, it was determined that there was a significant positive relationship between school counsellors' job satisfaction and professional self-esteem. In addition, job satisfaction of school counsellors working in the private sector was found to be higher than those working in the public sector. It was found that job satisfaction of school counsellors did not differ significantly according to gender, age and school level variables.

Key words: School counsellors, Job satisfaction, Professional self-esteem, Psychological counselling and guidance

Introduction

George & Jones (2009) defined job satisfaction as a set of emotions and beliefs that individuals have in relation to their current job, and then graded it from extreme satisfaction to extreme dissatisfaction. Job satisfaction is described as one's having pleasure and desired outcomes in his/her professional life (Hoy & Tarter, 2011). In a different definition, it was expressed as satisfaction or dissatisfaction of employees in their work (Güçlü & Zaman, 2011). According to Akkuş (2010), job satisfaction is necessary for the establishment and continuity of workplace culture and a high level of job satisfaction of employees is important for individuals, institutions and societies.

Job satisfaction is a complex and broad concept, and its level of influence from different variables is higher. Therefore, it is impossible to predict job satisfaction by studying a single variable. Occupational activities can be important means to meet people's psychological needs as well as material needs. As Maslow points out, people have many different needs such as love, belonging, respect, status and self-actualization in addition to their physiological and security needs (Akbay, 2018). Also, as stated by Kuzgun et al. (1999), situations in which psychological needs such as self-expression, opportunity to use of abilities, and being successful increase individuals' job satisfaction. Swarnalatha & Vasantham (2014) stated that the main variables affecting job satisfaction are working conditions, opportunity for promotion, workload, stress, respectability at work, relations with their superiors and financial awards. Güçlü & Zaman (2011) classified the factors affecting job satisfaction as individual (age, gender, education level and seniority) and organizational (quality and wage of job, working conditions, promotion opportunities, colleagues, and management).

When the related literature was examined; it was found that the job satisfaction level of school counsellors was high (Cottrell & Barrett, 2016; DeMato, 2001; Güçlü & Zaman, 2011; Usta, 2017; Worrell, 2004). Besides, it was determined that school counsellors' job satisfaction had a significant positive relationship with listening skills and counselling self-efficacy (Ekşi et al., 2015), occupational problem identification and perception of occupational competence (Kocayörük, 2000; Yeşilyaprak, 2001), self-esteem (Kadıoğlu, 2014),

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professional development efforts (Kocabaş, 2019), and a significant negative relationship with professional burnout (Owen and Demir, 2015). In addition to the studies mentioned above, some studies revealed that job satisfaction of school counsellors differs according to various demographic features. In some articles, job satisfaction of female school counsellors was found higher (Aliyev & Tunç, 2015; Hamamcı et al., 2005), while in others the opposite was the case (Çulha, 2017; Kocabaş, 2019). Also, in some studies it was determined that job satisfaction increases as the age increases (Agnew et al., 2000; Alçekiç, 2011; Cirhinlioğlu & Demir, 2017; Worrell et al., 2006). When school counsellors were compared in terms of type of school they are employed, the studies showed that school counsellors working in private sector had higher job satisfaction than those working in public schools (Çulha, 2017; Kadıoğlu, 2014; Kağan, 2010; Köksal, 2019; Özen, 2011). In some studies, it was found that job satisfaction of school counsellors differed significantly according to the school level they serve (Çivilidağ, 2012; Dalçiçek, 2016).

It is thought that as in all occupational fields, the high level of professional self-esteem of professionals working in the field of education is likely to increase their job performance and efficiency. Educators who have an important role in the education of future generations ought to find their profession appropriate to them and work willingly (Işık, 2006). Tabassum & Ali (2012) stated that educators' improving their professional skills, self-renewal, and commitment to this profession is related to their professional self-esteem. Today, self is a concept that is widely used and associated with different variables and is defined as the whole of ideas, perceptions, emotions and evaluations developed by a person himself/herself (Bacanlı, 2005; Lawrence, 1996; Shavelson et al.,1976). Aydın (1996) extended the concept of self to one's self-evaluations, personal references, past experiences, plans for the future, and reflection of social roles in his/her mind. It is also emphasized that individuals are born in an environment, interact with this environment, reveal an identity, and their "self" is influenced positively or negatively by their surroundings (Özoğlu, 2007). Self-esteem is related to the ratings the person makes about his or her own characteristics (Khezerlou, 2014). In this context, self is expressed as the sum of the cognitive beliefs that people have about themselves, while self-esteem is explained as the emotional reactions that people have about themselves after they think about and evaluate themselves (Heatherton & Wyland, 2003).

According to Yörükoğlu (1993), every person has a self that s/he wants to reach and s/he struggles to reach this ideal self. The individual becomes happier as s/he approaches the ideal, and becomes unhappy as s/he moves away. One of the concepts that is thought to be related to the ideal self is the professional self. According to Işık (2006), the professional self is in a close relationship with the individual's decision on the profession, his/her professional performance, expression of himself/herself through professional activities and living his/her own values. Therefore, the self-perceptions of the people should be compatible with the profession they have chosen. In addition, Kulaksızoğlu (2004) reported that professional self could be affected from people's needs, their attitudes towards their occupation, their plans for the future, their system of values, and their expectation from their family. Thus, there is a close relationship between the self-concept and the professional orientation of the person. Another concept thought to be as important as a professional self is professional self-esteem. Carmel (1997) considered the professional self as the attitude towards an individual's professional competence, performance, and attitude towards positive and negative aspects of the profession. Another concept thought to be as important as professional self is professional self-esteem which is defined as a judgment about one's building "self" relating to his/her occupation (Arıcak, 1999a).

It is thought that school counsellors' job satisfaction is related to their perception of this profession. As stated by Bond (2016), high level of professional self-esteem affects the professional life of psychological counsellors positively. As a matter of fact, it is not realistic to expect a successful career when a school counsellor's respect for his/her profession is low. Also, it seems impossible for such professionals to have a high level of job satisfaction. One of the measurements of professional respect is to be committed to the ethical rules and values. As Schmidt (2008) states, anyone who performs the school counseling profession is deemed to have accepted to act in accordance with the values and principles of this profession. In Turkey, one of the ethical principles in Code of Ethics for Psychological Counseling and Guidance (2011) published by the Turkish Psychological Counseling and Guidance Association is to have "the professional and scientific responsibilities". According to this principle, it is necessary for school counsellors to take responsibility for adhering to ethical standards, understanding the duties and roles, and behaving accordingly. In this way, it is possible for school counsellors to have job satisfaction. In other words, those school counsellors who do not fulfill their professional responsibilities can be supposed to have a low job satisfaction. In this context, it is considered that one of the variables thought to explain the job satisfaction of school counsellors is professional self-esteem. Therefore, it is important to examine the relation between the professional self-esteem of school counsellors and their job satisfaction. When the research done on this subject was examined, it was found that there is a positive relationship between school counsellors' self-esteem and job satisfaction (Kadıoğlu, 2014). According to another study, there is a positive relationship between school counsellors' professional self-esteem and need for achievement (Çivitci, 2010).

The results of the studies above show that in order to explain the job satisfaction of school counsellors, it is necessary to examine their professional self-esteem. One of the variables thought to predict the job satisfaction of school counsellors is amorality. Actually, amorality is not expected to be seen in school counsellors. It is thought that amorality can also be handled within the framework of ethics in the school counseling profession. It is very important for schools to provide school counseling services effectively by school counsellors who respect and are firmly committed to the ethical values of their profession. As a matter of fact, as Karaca & İkiz (2010) mentioned, the professionalism of school counseling requires being aware of and acting in accordance with the ethical principles of the profession. One of the ethical principles of psychological counsellors in the ACA Code of Ethics (2014), prepared by the American Counseling Association (ACA) is also expressed as "honesty" and principles of psychological counsellors in the Ethical Framework for the Counselling Profession (2018) created by the British Association for Counseling and Psychotherapy (BACP) is also expressed as "being trustworthy". Moreover, effective psychological counsellors are expected to demonstrate empathy, unconditional acceptance, natural, honest, sincere, willing and spontaneous behavior in their interactions with their clients (Cormier & Hackney, 2015; Egan, 2013). Thus, it is considered that amorality is a behavior that does not match the characteristics that school counsellors should have and may affect their job satisfaction negatively.

One of the variables thought to predict the job satisfaction of school counsellors is distrust of others. The concept of distrust of others can be discussed within the framework of the concept of cooperation. Distrust of others is thought to be a feature that school counsellors should not have because school counsellors need to have a trust-based relationship with their colleagues. As a matter of fact, consultation services, which are one of the service types of school counseling, are expressed as the studies carried out in order to cooperate with administrators and teachers and to develop common understanding within the scope of school guidance services (Yeşilyaprak, 2004). Also, one of the basic principles of counselling services is cooperation. Cooperation is based on the mutual assistance of school counsellors with all stakeholders of the school (Kuzgun, 2006). As Schmidt (2008) stated, it is not possible to achieve success in the school counselling profession in an environment where school counsellors, administrators and teachers do not work in cooperation. At this point, it can be said that school counsellors should develop a trust-based relationship with other stakeholders rather than distrust of others. Therefore, distrust of others may be a quality that may negatively affect the job satisfaction of school counsellors.

One of the variables thought to predict the job satisfaction of school counsellors is desire for control. Burger (1992) and Burger & Cooper (1979) used this concept to define the desire of individuals to control events throughout their lives. People with higher desire for control than others are generally defined by others as determined, willing to influence others, and assertive (Amoura et al., 2014). As a matter of fact, it was pointed out that individuals with high desire for control prefer to make their own decisions and take action to prevent a possible loss of control (Burger, 1985). Based on these explanations, it can be said that school counsellors are not expected to have a desire for control. It is because they are taught that it is beneficial to cooperate with and interact with other stakeholders within the framework of cooperation and democratization, which is one of the principles of school counselling. In this context, it was stated that caring about the ideas of teachers and administrators, getting their support and cooperating with them will increase the effectiveness and efficiency of the services to be provided (Çetinkaya, 2009). In addition, as Doğan (2000) stated, it is not according to an authority or hierarchical understanding in order to achieve success in the school counselling profession; it is necessary to act according to democratic, libertarian and individualization understanding. Therefore, it was considered that desire for control could have negative effects on job satisfaction of school counsellors.

Another variable thought to predict the job satisfaction of school counsellors is desire for status. Anderson et al. (2015) states desire for status as a basic human motivation. Desire for status is about the individual's being motivated by external goals such as wealth, power, and status rather than intrinsic goals like self-development and self-worth. Based on these explanations, it is not appropriate for school counsellors to have a desire for status. It is because, as Guy (1987) stated, one of the motivation sources that should not be seen in school counsellors is the desire for power. According to Cormier & Cormier (1991), a psychological counsellor should have goodwill. Goodwill requires that the psychological counsellors take care of the client's interests, and that it is based on satisfying the client's needs, not their own needs. It is also stated that psychological counsellors are a virtue to commit themselves to the good of their professions and clients (Cormier & Hackney, 2015). It was emphasized that school counseling is a field of study focused on serving people and should be done primarily for the benefit of the individual and society. Also, they are expected to serve for people's mental health, happiness, and well-being (ACA Code of Ethics, 2014). From this point of view, it was considered that school counsellors' having a desire for status can affect their job satisfaction negatively.

When the relevant literature was examined, no research was found on school counsellors examining variables such as amorality, distrust of others, desire for control and desire for status. However, it was determined that there were various studies on school counsellors and ethics (Camadan, 2018; Campbell, 2004; Hubert & Freeman, 2004; İkiz, et al., 2017a; İkiz et al., 2017b; Lambie et al., 2011; Lawrence & Kurpius, 2000; Lehr et al., 2007; Mullen et al., 2014; Mullen et al., 2016; Neukrug & Milliken, 2011; Taşdan & Yalçın, 2007). The results of those studies indicate that ethics is an important issue for the school counseling profession and the behavior of school counsellors must be ethical. The aforementioned variables, which are thought to have a negative relationship with ethical behavior, are regarded important and worth investigating for school counsellors.

When the results of the studies above were examined, it could be understood that as the professional self-esteem of the individuals increases, the positive situations in their professional lives increase. Similarly, amorality, distrust of others, desire for control and desire for status are important variables that may negatively predict the school counsellors' professional lives. In addition, in the light of the explanations above, it is estimated that there is a significant relationship between school counsellors' professional self-esteem and their amorality, distrust of others, desire for control and desire for status. As a matter of fact, a school counsellor with a high level of professional self-esteem is expected to be helpful, decisive, sincere, committed to ethical values and honest in his professional activities. For this reason, it is assumed that there is a negative relationship between the professional self-esteem of school counsellors and their amorality, distrust of others, desire for control, and desire for status.

When the relevant literature was examined, no studies that investigated job satisfaction together with the variables mentioned above were found. Therefore, it is anticipated this present study will contribute to the literature. Besides, it is expected that the discovery of the effects of those variables on school counsellors' job satisfaction will provide implications that could be taken into account in the professional education and development of school counsellors. Also, in the literature it was seen that these variables show differences according to various demographic variables. In this context, it was thought that examining the variables of the study in terms of some demographic variables is worth investigation. The aim of this study, therefore, is to seek the role of professional self-esteem, amorality, distrust of others, desire for control and desire for status on job satisfaction of school counsellors. Besides, it was attempted to reveal whether these variables significantly differ in terms of gender, school type, school level and age.

Method

Research Model

This research was carried out within the framework of relational screening model. Relational screening is a research model used to determine whether there is a joint variation between two or more variables and its degree if there is. In other words, the relations between two or more characteristics are examined in this model (Karasar, 2008). In this study, the relationship between job satisfaction of school counsellors and their professional self-esteem, immorality, distrust of others, desire for control and desire for status were examined. Also, whether these variables differ in terms of gender, school type, school level and age were examined.

The Study Group

The study group is composed of 194 school counsellors employed in Artvin, Rize and Trabzon provinces (Turkey). 145 of them are female (74.70%) and 49 are male (25.30%). 131 of the school counsellors work in public schools (67.50%) and 63 in private schools (32.50%). Also, 40 of the participants teach in primary school (20.60%), 90 in middle school (46.40%) and 64 in high school (33.00%). In addition, 60 of the participants are at the age of 22-24 (30.90%), 50 of them are 25-26 years old (25.80%), 40 of them are in between 27-30 (20.60%) and 44 of those are in between 31-48 (22.70%).

Instruments

The Job Satisfaction Scale, Arıcak Professional Self-esteem Scale, Machiavellianism Scale and *Personal Information Form* were used as instruments in the present study. Utilization permits of the scales were taken.

Job Satisfaction Scale

This scale was developed by Kuzgun et al. (1999) in order to determine the satisfaction that individuals receive from their work. The scale consists of 20 items and is in 5-point Likert type of scale formation. As a result of the factor analysis carried out in order to determine the validity of the scale, it was understood that it consists of two dimensions; "suitability to qualifications" and "development opportunity (request)". The total variance explained by the two factors is 48.6%. Besides, it can be used by calculating the total score of the scale.

The Cronbach alpha of the scale's total was found to be .90. Based on these results, the scale was considered valid and reliable. In this study, the measurement tool was used by calculating the total score. The validity and reliability of the scale was tested in the context of this research. According to the result of confirmatory factor analysis for validity, goodness of fit index was found at the acceptable level (χ^2/df=3.44, CFI=.92, RMSEA=0.06, SRMR=0.07) (Kline, 2005). The Cronbach alpha was calculated and found to be .84 for the total of the scale.

Arıcak Professional Self-esteem Scale

This scale was developed by Arıcak (1999b) and consists of 30 items: 14 positive (2, 5, 7, 9, 11, 13, 14, 16, 18, 20, 24, 26, 28, 30) and 16 negative (1, 3, 4, 6, 8, 10, 12, 15, 17, 19, 21, 22, 23, 25, 27, 29). The scale is in 5-point Likert type of scale formation and used by calculating the total score. To ensure content validity, the items which were agreed on by 75% of the expert group are included in the scale. Factor analysis was performed to determine the construct validity and it was determined that the total variance explained by the one-dimensional structure of the scale was 59.37%. The calculated Cronbach alpha of the scale is .93. The test-retest reliability coefficient of the scale was found to be .90. As a result, it was concluded that the scale was valid and reliable. In this study, the measurement tool was used by calculating the total score. The validity and reliability of the scale was tested in the context of this research. According to the result of confirmatory factor analysis for validity, goodness of fit index was. found at the acceptable level (χ^2/df=4.85, CFI=.90, RMSEA=0.07, SRMR=0.08) (Kline, 2005). The Cronbach alpha was calculated and found to be .81 for the total of the scale.

Machiavellianism Scale

The original form of the scale was developed by Dahling et al. (2009) and was adapted to the Turkish version by Ülbeği (2016). The scale consists of 16 items in four dimensions: “amorality”, “distrust for others”, “desire for control” and “desire for status”. Factor analysis was performed to determine the construct validity. It was determined that factor loads varied between .72 and .82 and the four dimensions explained 67% of the total variance. The calculated Cronbach alpha for the reliability of the sub-dimensions of the scale, amorality, distrust for others, desire for control and desire for status were found to be .86, .82, .83, and .80, respectively. According to these results, it was concluded that the scale was valid and reliable. In this study, the measurement tool was used by calculating the sub-dimensions. The validity and reliability of the scale was tested in the context of this research. According to the result of confirmatory factor analysis for validity, goodness of fit index was found at the acceptable level (χ^2/df=3.12, CFI=.93, RMSEA= 0.06, SRMR=0.06) (Kline, 2005). The Cronbach alpha was calculated. The score of the sub-dimensions were found as follows: amorality=.72, distrust for others=.76, desire for control= .79, and desire for status=.72.

Demographic Information Form

This form was developed for this present research so as to collect information regarding the participants’ age, gender, school type (public-private) and school level (primary school-secondary school-high school) where they are currently working.

Collection of the Data

Prior to the application of measurement tools, approval was obtained from the Recep Tayyip Erdogan University Social and Humanities Ethics Committee on the ethical compliance of the practice. Then, the purpose of the research and the measurement tools were presented to the National Education Directorates in 3 different cities (Artvin, Rize and Trabzon) where the measurement tools were applied, and their application permissions were requested. Thereupon, the “Ethics Committees” in those directorates conducted the necessary examinations and allowed the implementation of the measurement tools. It took approximately half an hour to fill out the measurement tools by one participant. Four researchers also took part in the application of the measurement tools. Within the scope of the research, 18 schools in Artvin, 22 schools in Rize and 38 schools in Trabzon were visited. It took about a month to collect the data as the researchers could visit only a few schools each day.

Analysis of the Data

Multiple regression analysis was performed on the data obtained in order to reveal the role of professional self-esteem and distrust for others of school counsellors. To do this analysis, there must be several assumptions: 1. Multicollinearity and Singularity, 2. Extreme Values, 3. Adequate Sampling Size, and 4. Normality of Distribution (Seçer, 2013). Before the analysis was conducted, the necessary assumptions were tested. These assumptions were found to be satisfied. Then multiple regression analysis was done. In addition, these variables studied in the research were analyzed in terms of various demographic variables (gender, school

type, school level and age) by independent t-test and ANOVA. Analysis of the data was carried out with the SPSS 22.

Results

Results about the Test of the Assumptions of Multiple Regression Analysis

Multicollinearity and Singularity

That the relationship among the predictive variables in multiple regression analysis is high is regarded as a problem. It is suggested that this correlation values must not be above .90 (Pallant, 2015). Correlation analysis was performed to determine the relationship between the variables and is presented in Table 1.

Table 1. Correlations Between Variables

	1	2	3	4	5	6
(1) Professional Self-Esteem	1					
(2) Amorality	-.232**	1				
(3) Distrust for Others	-.242**	.365**	1			
(4) Desire for Control	-.070	.292**	.333**	1		
(5) Desire for Status	-.156*	.305**	.394**	.483**	1	
(6) Job Satisfaction	.726**	-.053	-.216**	-.115	-.130	1
Mean	4.092	1.601	2.117	2.994	2.829	3.865
Sd	.543	.573	.735	.876	.908	.498

** p< .01 * p< .05

As a result of the correlation analysis between the variables, it was found that there was a low negative correlation between professional self-esteem and amorality (r=-.232), distrust for others (r=-.242), desire for control (r=-.070), and desire for status (r=-.156). Therefore, it was concluded that there is not a problem of multicollinearity and singularity between the predictive variables. In the test of these assumptions, the Variance Inflation Factor (VIF) and Tolerance Value (TV) were also calculated. According to Pallant (2015), the TV value must be greater than .10 and the VIF value must be less than 10. In these analyzes it was understood that there is not a problem of multicollinearity between variables. It was also checked whether there was autocorrelation between the independent variables. For this purpose, the Durbin-Watson coefficient was calculated. This value is expected to be between 1.5 and 2.5 (Kalaycı, 2009). It was understood that the calculated Durbin-Watson coefficient value was 1.774; therefore, there was no autocorrelation between the variables (Table 3).

Extreme Values

In the study, it was tested whether the data had univariate and multivariate extreme values. To determine the univariate extreme values, z scores calculated regarding the data were examined. The data obtained with a standard z score of greater than 3.29 were reported to have extreme values (Tabachnick and Fidell, 2015). As a result of the analyses made, it was determined that there was no data with this value. The Mahalonobis distance was calculated to examine the multivariate extreme values. Considering that there are five independent variables in the study, it was stated that Mahalonobis value which is higher than the degree of freedom value (20.52) corresponding to 0.001 significance level in the critical values of the chi-square (x^2) distribution table is the extreme value (Tabachnick and Fidell, 2015). As a result of the analyses made, four data which exceed the aforementioned values were excluded from the study because it is suggested to remove them from the data set (Pallant, 2015). In this way, it was tried to overcome the multivariate extreme value problem.

Adequate Sampling Size

This research was performed on 200 school counsellors. However, two of them left most of the items in the scales unanswered and so they were excluded from the sample group. As mentioned before, four of them had extreme values and those were also excluded from the study. After these stages, the sample of the study was clarified as 194 people. With regard to determining the adequacy of the sample size, Tabachnick and Fidell (2015) developed the formula "N≥50+8m (m=number of independent variables)". Taking this formula into consideration, it is considered that the sample size is adequate (194>90) as there are two independent variables in the study.

Normality of Distribution

Skewness and kurtosis coefficients were calculated in order to test whether the variables have normal distribution. The obtained results are presented in Table 2.

Table 2. Skewness and Kurtosis Coefficients Related to the Variables of the Study

Variable	Skewness	Kurtosis	$\bar{x}$	Sd
Job Satisfaction	-.392	-.340	3.865	.498
Professional Self-Esteem	-.450	-.386	4.092	.543
Amorality	.813	.037	1.601	.573
Distrust for Others	.409	-.367	2.117	.735
Desire for Control	-.080	-.388	2.994	.876
Desire for Status	-.097	-.444	2.829	.908

To Çokluk, Şekercioğlu and Büyüköztürk (2012), when the skewness and kurtosis coefficients are between -1 and +1, the distribution could be accepted normal. When the values in Table 2 are examined, it is seen that the variables are between -1 and +1 and therefore it is accepted that the normal distribution is provided.

Results about the Multiple Regression Analysis

Multiple regression analysis was conducted to examine the role of independent variables on job satisfactions of school counsellors, which is the main objective of this study. The obtained results are presented in Table 3.

Table 3. Multi-Regression Analysis to Predict Job Satisfaction of School Counsellors

Variable	B	Std. Error	β	t	p	Zero Order	Partial	TV	VIF	Durbin-Watson
Constant	1.241	.223		5.562	.000**					
Professional Self-Esteem	.657	.047	.716	13.985	.000**	.726	.711	.942	1.062	1.774
Distrust for Others	-.029	.035	-.043	-.849	.397	-.216	-.061	.942	1.062	

R= .73 R^2=.53 $F_{(2\text{-}191)}$= 107.284 p=.000 p<.001**

According to the t-test results calculated regarding the significance of the regression coefficients in Table 3, it was understood that only professional self-esteem explained job satisfaction significantly (β=.716, p<.001). However, distrust for others did not explain job satisfaction significantly (β=-.043, p>.05)

Results about the Demographic Variable

In this study, it was tried to determine whether job satisfaction, professional self-esteem, amorality, distrust for others, desire for control and desire for status differed in terms of demographic variables. The results of independent t-test to determine whether school counsellors' job satisfaction, professional self-esteem, amorality, distrust for others, desire for control and desire for status differ significantly in terms of gender are shown in Table 4.

Table 4. Examining the Characteristics of School Counsellors in Terms of Gender

Variable	Gender	n	$\bar{x}$	sd	df	t	p
Job Satisfaction	Female	145	3.88	.51	192	.511	.610
	Male	49	3.83	.48			
Professional Self-Esteem	Female	145	4,12	.53	192	1.064	.289
	Male	49	4.02	.58			
Amorality	Female	145	1.57	.56	192	-1.371	.172
	Male	49	1.70	.62			
Distrust for Others	Female	145	2.13	.76	192	.305	.761
	Male	49	2.09	.68			
Desire for Control	Female	145	2.96	.87	192	-1.053	.294
	Male	49	3.11	.91			
Desire for Status	Female	145	2.80	.93	192	-.667	.506
	Male	49	2.90	.84			

When Table 4 was examined, it was understood that gender is not a differentiation factor to job satisfaction, professional self-esteem, amorality, distrust for others, desire for control and desire for status of school counsellors. The results of independent t-test to determine whether school counsellors' job satisfaction, professional self-esteem, amorality, distrust for others, desire for control and desire for status differ significantly in terms of school type where they serve are shown in Table 5.

Table 5. Examining the Characteristics of School Counsellors in Terms of School Type

Variable	School Type	n	$\bar{x}$	sd	df	t	p

Job Satisfaction	Public	131	3.80	.50	192	-2.799	.006
	Private	63	4.01	.47			
Professional Self-Esteem	Public	131	4,05	.57	192	-1.641	.103
	Private	63	4.18	.48			
Amorality	Public	131	1.58	.55	192	-.676	.500
	Private	63	1.64	.62			
Distrust for Others	Public	131	2.05	.67	192	-1.760	.080
	Private	63	2.25	.85			
Desire for Control	Public	131	2.97	.82	192	-.464	.643
	Private	63	3.04	.99			
Desire for Status	Public	131	2.77	.87	192	-1.248	.213
	Private	63	2.95	.98			

Table 5 shows that school type is a factor that differentiates school counsellors' job satisfaction, but not their professional self-esteem, amorality, distrust for others, desire for control or desire for status. The results of the ANOVA test to determine whether the school counsellors' job satisfaction, professional self-esteem, amorality, distrust for others, desire for control and desire for status differ significantly in terms of the school level they work are shown in Table 6.

Table 6. Examining the Characteristics of School Counsellors in Terms of School Level

Variable	School Level	n	$\bar{x}$	sd	df	F	p
Job Satisfaction	Primary	40	3.96	.51	2	.960	.385
	Secondary	90	3.84	.49	191		
	High	64	3.84	.51	193		
Professional Self-Esteem	Primary	40	4.24	.59	2	2.163	.118
	Secondary	90	4.07	.53	191		
	High	64	4.02	.52	193		
Amorality	Primary	40	1.55	.60	2	2.773	.065
	Secondary	90	1.53	.49	191		
	High	64	1.74	.64	193		
Distrust for Others	Primary	40	2.07	.79	2	.293	.746
	Secondary	90	2.16	.71	191		
	High	64	2.09	.74	193		
Desire for Control	Primary	40	2.88	.79	2	.486	.616
	Secondary	90	3.01	.86	191		
	High	64	3.04	.95	193		
Desire for Status	Primary	40	2.66	.93	2	1.123	.328
	Secondary	90	2.83	.92	191		
	High	64	2.93	.88	193		

When Table 6 was examined, it was observed the school level is not a differentiation factor to school counsellors' job satisfaction, professional self-esteem, amorality, distrust for others, desire for control and desire for status. The results of the ANOVA test to determine whether the school counsellors' job satisfaction, professional self-esteem, amorality, distrust for others, desire for control and desire for status differ significantly in terms of age are shown in Table 7.

Table 7. Examining the Characteristics of School Counsellors in Terms of Age

Variable	Age	n	$\bar{x}$	sd	df	F	p
Job Satisfaction	22-24	60	3.81	.51	3	1.684	.172
	25-26	50	3.77	.48	190		
	27-30	44	3.93	.51	193		
	31-48	40	3.97	.48			
Professional Self-Esteem	22-24	60	4.08	.58	3	1.250	.293
	25-26	50	3.99	.48	190		
	27-30	44	4.09	.55	193		
	31-48	40	4.22	.55			
Amorality	22-24	60	1.55	.52	3	2.404	.069
	25-26	50	1.76	.56	190		

	27-30	44	1.61	.61	193		
	31-48	40	1.45	.60			
Distrust for Others	22-24	60	2.11	.71	3	.077	.972
	25-26	50	2.16	.69	190		
	27-30	44	2.10	.81	193		
	31-48	40	2.12	.77			
Desire for Control	22-24	60	3.12	.83	3	.658	.579
	25-26	50	2.99	.84	190		
	27-30	44	2.89	.96	193		
	31-48	40	2.94	.91			
Desire for Status	22-24	60	2.92	.94	3	.281	.839
	25-26	50	2.78	.86	190		
	27-30	44	2.82	1.00	193		
	31-48	40	2.78	.83			

When Table 7 was examined, it can be stated that age is not a differentiation factor to school counsellors' job satisfaction, professional self-esteem, amorality, distrust for others, desire for control, and desire for status.

Discussion

One of the results of this study is that the professional self-esteem of school counsellors explains their job satisfaction positively and significantly. Bulut Yazıcı (2018) found that there is a positive and significant relationship between school counsellors' professional self-esteem and job satisfaction. It can be said that this result are parallel to the results obtained in this research. In the light of all these studies, it was understood that there is a positive correlation between the level of respect for the professions of the individuals and the satisfaction they receive from their work. In other words, those who respect their profession enjoy doing their jobs. In the theory put forward by Korman (1970) under the name of "balance", the view that professional self-esteem is a predictor of job satisfaction was supported. As Yeşilyaprak (2011) states, the profession of the person is a very important factor in meeting his physiological, psychological and social needs as well as attaining life satisfaction. It was stated that the person's perception about his profession is also a determinant of job satisfaction. According to Corey (2017), effective psychological counsellors know who they are, what they can do, what they expect from life, and what is important to them. They are aware of their strengths and weaknesses, accept them and respect themselves. They feel strong and sufficient but are not afraid to try innovations. They can rediscover and improve themselves. At this point, their respect for their profession is also important. As a matter of fact, since the school counselling profession is focused on providing services directly to people, it is unrealistic that school counsellors can be useful for someone who wants help if their professional self-esteem is not high. It is difficult to say that school counsellors, which cannot help their clients, will also have high job satisfaction. As Arıcak (1999a) also mentioned, high professional self-esteem is an effective factor for people to be successful and productive in their profession.

In the research, it was found that amorality, distrust for others, desire for control and desire for status dimensions do not significantly explain job satisfaction. In the related literature, no research on school counsellors examining these variables was found. In the previous studies carried on school counsellors, a positive relationship was found between their job satisfaction and organizational commitment, a term defined as the acceptance of organizational goals and values and a strong belief in them; extra efforts towards the achievement of organizational objectives; a strong desire to continue membership of the organization (Karaköse & Bozgeyikli, 2012; Güçlü & Zaman, 2011). Also, in some studies it was asserted that school counsellors who perceive school climate negatively have higher anxiety levels (Ekşi, 2006) and who exhibits behaviors with occupational compassion have higher job satisfaction (Tahincioğlu, 2018). Considering these explanations, it is thought that as school counsellors' positive thoughts, feelings and behaviors towards the institution they work for increase, they will experience more job satisfaction.

Another striking result of this study is that there is a significant and negative relationship between school counsellors' professional self-esteem and amorality, distrust for others, and desire for status. As for desire for control, there is a negative relationship between professional self-esteem and it; however, it is not statistically significant. It was therefore understood that as school counsellors' professional self-esteem increases, these variables decrease. In the related literature, no research on school counsellors regarding this issue was found. As a consequence, it can be said that such behaviors as opportunism and seeking personal interest in an institution are incompatible with the respect people have to their profession. As a consequence, it can be said that such behaviors as unethical behavior, opportunism and seeking personal interest in an institution

are incompatible with the respect people have to their profession. In this context, it was stated that school counsellors have certain ethical principles that they should pay attention to as a requirement of respect for their profession, and these principles should be acted in order to make the right decisions in their work and to make the decisions based on substantive reasons (Corey, 2017). In this regard, the Ethical Standards for School Counsellors (2016), published by the American School Counsellor Association [ASCA], emphasize that counsellors should be committed to the principles of "beneficence", "autonomy", "nonmaleficence", "fidelity" and "justice" in their activities. In addition, it was noted that school counsellors should not manipulate the service they provide for their own interests (Nelson-Jones, 2013); instead, they should be reliable (Hackney & Cormier, 2015), concerned about the happiness of other people (Corey, 2017), virtuous (Cormier & Hackney, 2015) honest and sincere (Egan, 2013). Therefore, it can be said that the principles of school counselling, ethical behaviors in school counselling and the characteristics of school counsellors do not match with amorality, distrust for others, and desire for status. In this context, it can be said that the inverse relationship between professional self-esteem and amorality, distrust for others, and desire for status variables is an expected result for school counseling profession.

Based on the examination of school counsellors' job satisfaction in terms of demographic variables, no significant difference regarding gender was determined. It was seen that there are various research results supporting this result. Acar (2019); Alçekiç (2011); Cirhinlioğlu & Demir (2017), Dalçiçek (2016), Ekşi et al. (2015), Kadıoğlu (2014) Kağan (2010), and Uslu (1999) determined that job satisfaction does not differ significantly by gender as a result of their research on school counsellors. Unlike these results, Aliyev & Tunç (2015) and Hamamcı et al. (2005) determined that females' job satisfaction is higher than males' in their study on school counsellors. Çulha (2017) and Kocabaş (2019) revealed that male school counsellors have higher job satisfaction than the females. In this context, it is understood that there are studies with different results. According to the results of this present study, it can be stated that gender is not a variable explaining the school counsellors' job satisfaction. The reason for this may be the fact that the roles, duties, and responsibilities in the professional life are mostly distributed without considering the gender factor. In this way, it can be said that this job and job satisfaction is prevented from forming a sexist character.

As a result of the research, it was concluded that the job satisfaction of school counsellors did not differ significantly according to their age. In studies conducted on this subject, it was observed that there are research results similar to this result. For example, Acar (2019), Bayrı (2006), Dalçiçek (2016), Güçlü & Zaman (2011), Hamamcı et al. (2005) and Kocayörük (2000) determined as a result of their research on school counsellors that the job satisfaction of the participants did not differ according to their age. Unlike these results, Çulha (2017) and Kocabaş (2019) found that younger school counsellors had higher job satisfaction than the older ones. Agnew et al. (2000), Alçekiç (2011), Cirhinlioğlu & Demir (2017) and Worrell et al. (2006), in their study on school counsellors, determined that the job satisfaction of school counsellors increases with age. As a result of these studies above, age is a differentiating factor to job satisfaction. The results in the mentioned studies contradict the result of this research. According to the results obtained from this research, there is no age differentiate on the job satisfaction of the school counsellors. In this case, it can be said that a person who has just started his/her career and the person who has worked for many years in his/her profession can show similarity or difference in job satisfaction level. Indeed, a new employee's enthusiasm and curiosity may be in his/her favor, or a senior employee's successful experience and career might give rise to a high level of job satisfaction.

It was also understood that school counsellors working in private institutions have a higher job satisfaction than those in public schools. When the related literature was examined, it was seen that there were several studies with similar results. In Çulha's (2017) study with 104 participants 44 of whom work in the private sector and 60 in the public sector, in Kağan's (2010) study with 202 participants 42 of whom work in the private sector and 160 in the public sector, in Köksal's (2019) research with 240 participants 39 of whom work in the private sector and 201 in the public sector, in Özen's (2011) research with 212 participants 47 of whom work in the private sector and 165 in the public sector, and in Kadıoğlu's (2014) study with 297 participants 29 of whom work in the private sector and 268 in the public sector, it was determined that job satisfaction of school counsellors working in the private sector is higher than that of public institutions. Considering the results of the studies in the literature and this very research, it was understood that private schools can contribute more to job satisfaction than public schools. This may be related to the success-oriented examination system in Turkey because private schools can compete more than public schools for the success of their students. This competitive environment may be less common in public schools. This situation may cause employees in private schools to act with higher motivation than those working in public schools. School counsellors can also be affected by this competitive environment. With the effect of this competitive environment, the job satisfaction of school counsellors working in private schools may be higher than those working in public schools. Similarly, it can be said that this situation is also seen in the reward system. The functioning of public schools may be more stringent than private schools. With the effect of this, a person who does his/her job well in the public sector

may not be rewarded enough, while a person who works well in the private sector can be rewarded materially and morally. This situation can increase the job satisfaction of the employees in private schools. For this reason, it is thought that the job satisfaction of school counsellors in private institutions may be higher than those in public institutions.

In this study, it was determined that the last demographic variable, school level in which school counsellors work (primary/secondary/high school), did not lead to any significant differentiation in the job satisfaction of school counsellors. When the studies conducted on this variable were examined, the result of the research done by Ekşi et al. (2015) was similar to this present study. They conducted the research on 57 school counsellors who were working in primary school, 60 in secondary school and 43 in high school and noted that school level did not differentiate to job satisfaction. Hamamcı et al. (2005) stated that job satisfaction of school counsellors working in primary and high school did not differ according to the school level they work at. Kadıoğlu (2014) found that job satisfaction of school counsellors who work in primary, secondary, high school, special education center and guidance and counselling research center does not differ from each other. Differing from these results, Çivilidağ (2012) found that the job satisfaction of school counsellors who work in primary school was higher than that of those working in secondary school. The participants of his research were 91 school counsellors; 54 were working in primary schools and 37 in secondary schools. In the study conducted by Dalçiçek (2016), it was determined that the job satisfaction of 147 school counsellors working in primary school was higher than that of 76 school counsellors working in pre-school education institutions. It was understood that researchers are not in agreement on this subject. As for this present study, it was found that school level does not differentiate significantly job satisfaction of school counsellors. As a result, for school counsellors who want to be satisfied with their occupation, it can be said that they can improve themselves and satisfy themselves by taking advantage of the problems encountered regardless of the school level.

Based on the examination of professional self-esteem in terms of demographic variables, first of all, no significant gender difference was found among school counsellors. Similar to these results, it was determined in the studies conducted by Er (2017) and Kutlu & Soğukpınar (2015) that school counsellors do not show a significant difference according to their gender. Unlike these results, Arıcak & Dilmaç (2003) and Çivitçi (2010) found that the professional self-esteem of female school counsellors was higher than male school counsellors. Considering the results obtained from this research, it was seen that gender does not make a significant difference to explain the respect of the school counsellors for their profession.

As for age variable, there was no significant difference in terms of the professional self-esteem level of school counsellors. In the research conducted by Er (2017), Foster (2010) and Kutlu and Soğukpınar (2015), it was determined that the professional self-esteem of school counsellors does not differ significantly according to their age. In contrast to these results, the research conducted by Bulut Yazıcı (2018) determined that there is a negative relationship between school counsellors' professional self-esteem and age. According to the results obtained from this research, it was understood that the age of school counsellors is not a variable that differentiates their professional self-esteem.

When whether the school counsellors' professional self-esteem differ according to school types (public/private) was investigated, no significant difference was found. In the related literature, no research was found in which the professional self-esteem of school counsellors was examined in terms of school type.

Upon the examination of last variable, school level (primary/secondary/high school), no significant difference among school counsellors was detected in terms of job satisfaction. Some studies on this subject were found. In the research conducted by Kutlu & Soğukpınar (2015), it was determined that there was no significant difference regarding the professional self-esteem of the school counsellors who work in the primary, secondary, high school and guidance and counselling research centers. Similarly, in a study conducted by Foster (2010), it was determined that there was no significant difference among the self-esteem of school counsellors who work in pre-kindergarten, middle/junior high school or high school. The result is in harmony with the result of these studies. This situation could be explained as the fact that the primary and secondary school classes are mostly located in the same buildings, which reduces the impact of school level. This might be resulted from the fact that in Turkey, primary school and middle school students are studying in the same building and high schools in many cities are located in the same campus with primary and secondary schools. Therefore, this situation may cause school counsellors not to experience the perception that they work at different school levels.

Within the scope of the research, it was investigated whether the behaviors of school counsellors differ in terms of amorality, distrust for others, desire for control, and desire for status in terms of various demographic variables. In the related literature, no research on school counsellors on these variables was found. After the examination of these variables in terms of demographic variables, no significant gender difference was found among school counsellors. It can be said that the result obtained from this research is the effect of male and female working under similar conditions in the globalizing world. Hence, this result can be interpreted as

the effect of gender gap in the business environment decreases. When it comes to age variable, no significant difference was determined regarding school counsellors' amorality, distrust for others, desire for control, and desire for status, either. According to the results, the increase or decrease of the ages of the school counsellors does not change their amorality, distrust for others, desire for control, and desire for status. Therefore, it is understood that these behaviors do not occur with increasing or decreasing age, but with the effect of different psychological variables. It was also found that the school counsellors' amorality, distrust for others, desire for control, and desire for status do not differ significantly in terms of the school type in which they are employed. According to these results, it was understood that school counsellors' amorality, distrust for others, desire for control, and desire for status show no difference whether they work in a public or private school. Given that in recent years, the income gap between school counsellors in private and public schools has decreased and both sectors provide similar rights and privileges, which can be interpreted as an expected result that individuals' amorality, distrust for others, desire for control, and desire for status are similar to each other. It was determined that school counsellors' amorality, distrust for others, desire for control and, desire for status do not change by working in primary, secondary or high school. According to the result of this present study, it can be said that the coexistence of culture and the similar education and training environments in which the school counsellors are working may prevent the differentiation of their amorality, distrust for others, desire for control, and desire for status.

Recommendations

In this study, school counsellors working in private institutions were found to have more job satisfaction than those who work in public schools. Based on this result, the working conditions of the public institutions in which the school counsellors are working can be improved to influence their job satisfaction positively. For example, the provision of the rooms, the tests and the materials that school counsellors need may increase their job satisfaction.

In future studies, school counsellors' job satisfaction could be studied in terms of other variables (personality, school climate, organizational commitment, professional burnout and so forth). In addition, more detailed information can be obtained through qualitative research. For instance, in this study school counsellors working in private institutions were found to have more job satisfaction than those who work in public schools. The personal or social reasons of this result can be examined in more detail through interviews. In addition, it is thought that a focus group study on job satisfaction with school counsellors can yield important results.

Besides, based on the positive relationship between job satisfaction and professional self-esteem, some steps that will promote the professional self-esteem can be taken in the trainings to be held with school counsellors. In this context, theoretical and practical trainings on the importance of the school counselling for the individual and society, professional ethics, ways to communicate effectively with other stakeholders working in schools, and so on could be provided. Moreover, it is thought that it would be beneficial to consider the results obtained in the study in the education of the candidates of school counsellors.

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References

ACA Code of Ethics (2014). American Counselling Association (ACA). Alexandria, VA: American Counseling Association. https://www.counseling.org/resources/aca-code-of-ethics.pdf

Acar, H. (2019). Rehberlik ve araştırma merkezinde çalışan öğretmenlerin genel özyeterlilik algıları ve iş doyumu düzeylerinin incelenmesi [Examination of job satisfaction levels and general self-efficacy perceptions of teachers working in guidance and research centers] [Unpublished master's thesis]. Ankara Hacı Bayram Veli University.

Agnew, T., Vaught, C. C., Getz, H. G. & Fortune, J. (2000). Peer group clinical supervision program fosters confidence and professionalism. *Professional School Counseling, 4*, 6-15. https://www.researchgate.net/publication/234619478_Peer_Group_Clinical_Supervision_Program_Fosters_Confidence_and_Professionalism

Akkuş, O. (2010). Rehberlik araştırma merkezlerinde görevli rehber öğretmenlerin iş doyumu düzeylerinin değerlendirilmesi [The evaluation of the job satisfaction levels of the guidance counsellors working at the guidance research centers] [Unpublished master's thesis]. Ankara University.

Alçekiç, K.G. (2011). Kariyer gelişimi açısından psikolojik danışmanların mesleki doyum ve değerlerinin incelenmesi [Research on psychological counselors' job satisfactions and values according to their career developments] [Unpublished master's thesis]. Marmara University.

Aliyev, R., & Tunç, E. (2015). Self-efficacy in counseling: The role of organizational psychological capital, job satisfaction, and burnout. *Procedia-Social and Behavioral Sciences, 190,* 97-105. https://doi.org/10.1016/j.sbspro.2015.04.922

Amoura, C., Berjot, S., Gillet, N., & Altintas, E. (2014). Desire for control, perception of control: Their impact on autonomous motivation and psychological adjustment. *Motivation and Emotion, 38,* 323-335. https://doi.org/10.1007/s11031-013-9379-9

Anderson, C., Hildreth, J. A. D., & Howland, L. (2015). Is the desire for status a fundamental human motive? A review of the empirical literature. *Psychological Bulletin, 141*(3), 574-601. https://doi.org/10.1037/a0038781

Arıcak, T. (1999a). Öğretmen adaylarının benlik saygısı ve mesleki benlik saygılarının geliştirilmesine yönelik bir grupla psikolojik danışma uygulaması [Psychological counseling practice with a group aimed at improving teacher candidates' self-esteem and professional self-esteem]. *Marmara University Atatürk Educational Faculty Journal of Educational Sciences, 11*(11), 11-22. https://dergipark.org.tr/en/pub/maruaebd/issue/380/2474

Arıcak, T. (1999b). Grupla psikolojik danışma yoluyla benlik saygısısının geliştirilmesi [Self-esteem and vocational self-esteem enhancement through group counseling] [Unpublished doctoral dissertation]. Marmara University.

Arıcak, T. & Dilmaç, B. (2003). Psikolojik danışma ve rehberlik öğrencilerinin bir takım değişkenler açısından benlik saygısı ile mesleki benlik saygısı düzeylerinin incelenmesi [An investigation on self-esteem and vocational self-esteem of counseling and guidance students]. *Trakya University Journal of Social Science, 3*(1), 1-7. http://dspace.trakya.edu.tr:8080/xmlui/handle/trakya/5820

Bayrı, H. (2006). Ortaöğretim kurumlarında çalışan psikolojik danışman/ rehber öğretmenlerin iş doyumuna ilişkin görüşlerinin değerlendirilmesi Güneydoğu Anadolu bölgesi örneği [Job satisfaction levels of counselors and guiding teachers employed at secondary and high schools in the Southeastern Anatolia region] [Unpublished master's thesis]. Dicle University.

Bond, T. (2016). *Standards and ethics for counselling in action*. Sage.

Bulut Yazıcı, E. (2018). Rehber öğretmenlerin iş doyumları ile kariyer yaşantıları, mesleki benlik saygıları ve kişisel sağlık davranışları arasındaki ilişki [The relationship between job satisfaction of school counselors and career experiences, occupational self-esteem and personal health behaviours] [Unpublished master's thesis]. Karadeniz Technical University.

Burger, J. M. (1985). Desire for control and achievement-related behaviors. *Journal of Personality and Social Psychology, 48*(6), 1520-1533. https://doi.org/10.1037/0022-3514.48.6.1520

Burger, J. M. (1992). *Desire for control: Personality, social, and clinical perspectives*. Plenum.

Burger, J. M. & Cooper, H. M. (1979). The desirability of control. *Motivation and Emotion, 3*, 381-393.

Camadan F. (2018). Psikolojik danışmanın yaşadığı çatışma: Etik ikilem [Psychological counsellor's conflict: Ethical dilemma]. *Sakarya University Journal of Education, 8*(1), 76-94. https://doi.org/10.19126/suje.333613

Campbell, M. A. (2004). What to do? An exploration of ethical issues for principals and school counsellors. *Principia: Journal of the Queensland Secondary Principals' Association*, 1, 7-9. https://eprints.qut.edu.au/4336/

Carmel, S. (1997). The professional self-esteem of physicians scale, structure, properties, and the relationship to work outcomes and life satisfaction. *Psychological Reports, 80*(2), 591-602. https://doi.org/10.2466/pr0.1997.80.2.591

Çetinkaya, Z. (2009). Türkçe öğretmen adaylarının öğretmenlik mesleğine ilişkin tutumlarının belirlenmesi. [Identifying Turkish pre-service teachers' attitudes toward teaching profession]. *İlkogretim Online, 8*(2), 298-305. http://ilkogretim-online.org//?mno=121417

Cirhinlioğlu, Z. & Demir, A. (2017). Özel Eğitim Kurumlarında çalışan rehber öğretmenlerin iş doyumları: İzmir örneği [Job satisfaction of advisors working in Private Educational Institutions: Izmir case]. *Journal of Human Sciences, 14*(2), 1690-1702. https://doi:10.14687/jhs.v14i2.4552

Çivilidağ, A. (2012). Okul psikolojik danışmanlarının psikolojik taciz ve yaşam doyumu düzeylerinin incelenmesi [An analysis of the mobbing and life satisfaction levels of school counsellors]. *Abant İzzet Baysal University Journal of Education Faculty, 12*(1), 129-144. https://dergipark.org.tr/tr/pub/aibuefd/issue/1504/18234

Çivitçi, A. (2010). Vocational self-esteem and psychological needs in Turkish counseling students. *International Journal for the Advancement of Counselling, 32*(1), 56-65. https://doi.org/10.1007/s10447-009-9089-x

Code of Ethics for Psychological Counseling and Guidance (2011). Turkish Psychological Counseling and Guidance Association Publishing. https://acikders.ankara.edu.tr/pluginfile.php/44163/mod_resource/content/0/PDR%20Etik.pdf

Corey, G. (2017). *Theory and practice of counseling and psychotherapy*. Nelson Education.

Cormier, S. & Hackney, H. L. (2015). *Counseling strategies and interventions for professional helpers*. Pearson.

Cormier, W. H. & Cormier, L. S. (1991). *Interviewing strategies for helpers*. Pacific Grove.

Cottrell, M. & Barrett, A. (2016). Job satisfaction among practicing school psychologists: The impact of SLD identification. *Contemporary School Psychology, 20*(1), 21-30. https://doi.org/10.1007/s40688-015-0076-4

Çulha, Y. (2017). Okul psikolojik danışmanlarının müdürlerinin liderlik stillerini algıları ile kendi iş doyumu ve tükenmişlik düzeyleri arasındaki ilişkinin incelenmesi [To examine the relationship between the perceptions of the leadership styles of the principals of school psychological counselors and their levels of job satisfaction and burnout] [Unpublished master's thesis]. Maltepe University.

Dahling, J. J., Whitaker, B. G. & Levy, P. E. (2009). The development and validation of a new Machiavellianism scale. *Journal of Management, 35*(2), 219-257. https://doi.org/10.1177/0149206308318618

Dalçiçek, E. (2016). Okul öncesi eğitim kurumlarında ve ilkokul kademesinde görev yapan rehber öğretmenlerin mesleki doyumlarının karşılaştırılması [Comparison of job satisfaction of counselors who work in preschool institutions and primary school level] [Unpublished master's thesis]. Van Yüzüncü Yıl University.

DeMato S. (2001). *Job satisfaction among elementary school counsellors in Virginia: Thirteen years later,* Blacksburg, Virginia.

Doğan, S. (2000). Türkiye'de psikolojik danışma ve rehberliğin durumu ve geleceğe ilişkin yönelimler. [Current status and future directions of counselling and guidance in Turkey]. *Education and Science, 25*(118), 3-8. http://egitimvebilim.ted.org.tr/index.php/EB/article/view/5294

Duncan, G. J. & Brooks-Gunn, J. (Eds.). (1997). *Consequences of growing up poor.* Russell Sage Foundation.

Egan, G. (2013). *The skilled helper: A problem-management and opportunity-development approach to helping.* Brooks Cole.

Ekşi, F. (2006). Rehber öğretmenlerin okul iklimi algıları ile kaygı düzeyleri arasındaki ilişki üzerine bir araştırma [An investigation on the relationship between anxiety and school climate amongst school counselors] [Unpublished master's thesis]. Marmara University.

Ekşi, H., Ismuk, E. & Parlak, S. (2015). Okul psikolojik danışmanlarında iş doyumunun yordayıcısı olarak psikolojik danışma özyeterliği ve dinleme becerileri. [In psychological counsellor self-efficacy beliefs and active listening skills as predictor of job satisfaction]. *Journal of Abant İzzet Baysal University Faculty of Education, 15*(2), 84-103. https://doi.org/10.17240/aibuefd.2015.15.2-5000161314

Er, A. Ç. (2017). Rehber öğretmenlerde mesleki benlik saygısı, duygusal zeka ve yaşam doyumlarının çeşitli değişkenler açısından incelenmesi [Examining of professional self-esteem, emotional intelligence and life satisfaction in psychological counselor in terms of various variables] [Unpublished master's thesis]. Necmettin Erbakan University.

Ethical Framework for the Counselling Professions (2018). The British Association for Counselling & Psychotherapy. BACP House. https://www.bacp.co.uk/media/3103/bacp-ethical-framework-for-the-counselling-professions-2018.pdf

Ethical Standards for School Counsellors (2016). Alexandria VA: American School Counsellor Association (ASCA). https://www.schoolcounselor.org/getmedia/f041cbd0-7004-47a5-ba01-3a5d657c6743/Ethical-Standards.pdf

George, M. & Jones G. (2009). *Understanding and managing organizational behavior*. Pearson Prentice Hall.

Güçlü, N. & Zaman, O. (2011). Alan dışından atanmış rehber öğretmenlerin iş doyumları ile örgütsel bağlılıkları arasındaki ilişki [The relationship between job satisfaction and organizational commitment among guidance teachers that were assigned out of their professional field]. *The Journal of Turkish Educational Sciences, 9*(3), 541-576.

Guy, J. D. (1987). *The personal life of psychotherapist*. Wiley.

Hackney, H. L. & Cormier, S. (2015). *The professional counsellor: A process guide to helping*. Pearson.

Hamamcı, Z., Oskargil Göktepete, E. & İnanç, N. (2005). Ankara ilinde çalışan okul psikolojik danışmanlarının mesleki gelişim ve mesleki doyum düzeyleri arasındaki ilişki. [The relationship between professional development and vocational satisfaction of school counsellors working in Ankara province]. *Turkish Psychological Counseling and Guidance Journal, 3*(24), 27-44. https://dergipark.org.tr/en/pub/tpdrd/issue/21443/229628

Helfer, M. E., Kempe, R. S. & Krugman, R. D. (1997). *The battered child.* University of Chicago Press.

Hoy, W. K. & Tarter, C. J. (2011). Positive psychology and educational administration: An optimistic research agenda. *Educational Administration Quarterly, 47*(3), 427-445. https://doi.org/10.1177/0013161X10396930

Hubert, R. M. & Freeman, L. T. (2004). Report of the ACA Ethics Committee: 2002-2003. *Journal of Counseling & Development, 82*, (2), 248-251. https://doi.org/10.1002/j.1556-6678.2004.tb00308.x

İkiz, F. E., Şensoy, G., Balkan, K. & Akıman, H. (2017b). Psikolojik danışmanların meslek etiğine yönelik algıları: Özel çalışanlara yönelik bir inceleme. [Perceptions of counselors about occupational ethics: Investigation on special workers]. *Journal of the Human and Social Sciences Researches, 6*(4), 152-171. http://www.itobiad.com/tr/pub/issue/30702/335114

İkiz, F. E., Sevinç, A., Kaval, A., Yeğintürk, G. & Kalen, S. (2017a). Okul psikolojik danışma hizmetlerinde mesleki etik ihtiyaçların belirlenmesi. [Determining the profession's ethical requirements in school psychological counseling services]. *Turkish Journal of Business Ethics, 10*(2), 223-245. http://dx.doi.org/10.12711/tjbe.2017.10.2.0011

Işık, N. (2006). Öğretmen adaylarının benlik kavramları ile mesleki benlik kavramları arasındaki bağdaşımın bazı değişkenlere göre incelenmesi: Selçuk Üniversitesi örneği [Investigation of the consistency between self-concept and vocational self-concept of the teacher candidates: Selcuk University sample] (Unpublished master's thesis). Selçuk University.

Kadıoğlu, F. (2014). Psikolojik danışmanların (Rehber öğretmenlerin) mesleki doyum ile kendine saygıları arasındaki ilişkinin incelenmesi [The investigation of the relationship between psychological counselors' job satisfaction and self-esteem] [Unpublished master's thesis]. Marmara University.

Kağan, M. (2010). Ankara ilindeki devlet ve özel ilköğretim okulları ile rehberlik ve araştırma merkezlerinde çalışan rehber öğretmenlerin iş doyumlarının incelenmesi. [Research on school counsellors' job satisfactions working at state and private elementary schools, and guidance and research centers in Ankara]. *Journal of Erzincan Education Faculty, 12*(1), 15-38. https://dergipark.org.tr/en/pub/erziefd/issue/5999/79987

Karaca, R. & İkiz, F. E. (2010). *Psikolojik danışma ve rehberlikte çağdaş bir anlayış [A contemporary understanding of psychological counseling and guidance]*. Nobel.

Karaköse, B. & Bozgeyikli, H. (2012). Örgütsel bağlılık ve çalışma yaşamı kalitesi arasındaki ilişki: Rehberlik araştırma merkezlerinde çalışan personel üzerine bir çalışma. [Relation between organizational commitment and professional quality of life: A study on staff who is working at counseling and

research centers]. *HAK-İŞ International Journal of Labor and Society, 1*(2), 164-180. https://dergipark.org.tr/tr/pub/hakisderg/issue/7578/99484

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. Guilford.

Kocabaş, H. (2019). Rehber öğretmenlerin mesleki doyum düzeylerinin mesleki gelişim çabaları açısından incelenmesi [Analysing the job satisfaction levels of school counselors in terms of their professional development efforts] [Unpublished master's thesis]. Bolu Abant İzzet Baysal University.

Kocayörük, E. (2000). Çeşitli değişkenlere göre rehber öğretmenlerin meslek doyumlarının karşılaştırılması [JOB satisfaction of the school counseler that shows difference for various variable is been compared] [Unpublished master's thesis]. Ankara University.

Köksal, H.K. (2019). Okul psikolojik danışmanlarının özel eğitim öz yeterlik algıları ile iş doyumları arasındaki ilişki: Mersin ili örneği [Relationship between special education self-efficacy perceptions and job satisfactions of school counsellors: Mersin example] [Unpublished master's thesis]. Cağ University.

Korman, A. K. (1970) Toward a hypothesis of work behavior. *Journal of Applied Psychology, 54,* 31-41. https://doi.org/10.1037/h0028656

Kulaksızoğlu, A. (2004). *Ergenlik psikolojisi [Adolescent psychology]*. Remzi.

Kutlu, M. & Soğukpınar, E. (2015). Rehber öğretmenlerin benlik saygısı ile mesleki benlik saygısı düzeylerinin çeşitli değişkenler açısından incelenmesi. [Examination of self-esteem and professional self-esteem levels of guidance teachers in terms of some variables]. *e-International Journal of Educational Research, 6*(1), 84-101. https://doi.org/10.19160/e-ijer.59310

Kuzgun, Y. (2006). *Rehberlik ve psikolojik danışma* [*Guidance and psychological counseling]*. Nobel.

Kuzgun, Y., Aydemir Sevim, S. & Hamamcı, Z. (1999). Mesleki doyum ölçeğinin geliştirilmesi. [Developing a job satisfaction scale]. *Turkish Psychological Counseling and Guidance Journal, 2*(11), 14-18. https://dergipark.org.tr/en/pub/tpdrd/issue/21431/229745

Lambie, G. W., Leva, K. P., Mullen, P. R. & Hayes, B. G. (2011). Ego development, ethical decision-making, and legal and ethical knowledge in school counsellors. *Journal of Adult Development, 18*(1), 50-59. https://doi.org/10.1007/s10804-010-9105-8

Lawrence, C. W. & Kurpius, S. E. R. (2000). Legal and ethical issues involved when counseling minors in nonschool settings. *Journal of Counseling & Development, 78*(2), 130-136. https://doi.org/10.1002/j.1556-6676.2000.tb02570.x

Lehr, R., Lehr, A., & Sumarah, J. (2007). Confidentiality and informed consent: School counsellors' perceptions of ethical practices. *Canadian Journal of Counselling, 41*(1), 16-30. https://files.eric.ed.gov/fulltext/EJ771972.pdf

Maslow, A.H. (1943). A theory of human motivation. *Psychological Review*, 50 (4), 430-437.

Mullen, P. R., Lambie, G. W. & Conley, A. H. (2014). Development of the ethical and legal issues in counseling self-efficacy scale. *Measurement and Evaluation in Counseling and Development, 47*(1), 62-78. https://doi.org/10.1177/0748175613513807

Mullen, P. R., Lambie, G. W., Griffith, C. & Sherrell, R. (2016). School counselors' general self-efficacy, ethical and legal self-efficacy and ethical and legal knowledge. *Ethics & Behavior, 26*(5), 415-430. https://doi.org/10.1080/10508422.2015.1033627

Nelson-Jones, R. (2013). *Practical counselling and helping skills: Text and activities for the life skills counselling model*. Sage.

Neukrug, E. S. & Milliken, T. (2011). Counsellors' perceptions of ethical behaviors. *Journal of Counseling & Development, 89*(2), 206-216. https://doi.org/10.1002/j.1556-6678.2011.tb00079.x

O'Neil, J. M. & Egan, J. (1992). Men's and women's gender role journeys: A metaphor for healing, transition, and transformation. In B. R. Wainrib (Ed.), *Gender issues across the life cycle* (pp. 107-123). Springer.

Owen, D. W. & Demir, A. (2015). Türk ve Amerikan psikolojik danışman eğitimcilerinde tükenmişlik riski ve iş doyumu. [Job satisfaction and burnout risk among American and Turkish counselor educators]. *Education for Life, 29*(1), 1-12. http://journals.iku.edu.tr/yed/index.php/yed/article/view/34

Özen, Y. (2011). Psikolojik danışmanların iş memnuniyetlerinin incelenmesi. [Research on school counsellors' job satisfactions]. *Turkish Journal of Business Ethics, 4*(7), 77-92. http://isahlakidergisi.com/content/6-sayilar/7-4-cilt-1-sayi/m0038/ozen.pdf

Plath, S. (2000). *The unabridged journals of Sylvia Plath.* Anchor.

Schmidt, J. J. (2008). *Counseling in schools: Comprehensive programs of responsive services for all students*. Pearson/Allyn and Bacon.

Seçer, İ. (2013). *SPSS ve LISREL ile pratik veri analizi*: *Analiz ve raporlaştırma* [P*ractical data analysis with SPSS and Lisrel]*. Nobel.

Tahincioğlu, D. (2018). Psikologların ve psikolojik danışmanların iş doyumu, çalışma yaşam kaliteleri ve merhamet düzeylerinin karşılaştırılması [Comparison of job satisfaction, work-life quality and compassion level between psychologists and psychological counselors] [Unpublished master's thesis]. Uskudar University.

Taşdan, M. & Yalçın, İ. (2007). Psikolojik danışma ve rehberlikte etik [Ethics in psychological counseling and guidance]. *Mehmet Akif Ersoy University Journal of Education Faculty,* 14, 99-107. https://app.trdizin.gov.tr/makale/T0Rnd05UazU/psikolojik-danisma-ve-rehberlik-te-etik-

Tavşancıl, E. (2002). *Tutumların ölçülmesi ve SPSS ile veri analizi [Measuring attitudes and data analysis with SPSS]*. Nobel.

Ülbeği, İ. D. (2016). Makyavelizm ölçeğinin güvenirlik ve geçerlik çalışması. [Investigation of the reliability and validity of the Machiavellian scale]. *Journal of Çukurova University Institute of Social Science, 25*(2), 89-100. https://dergipark.org.tr/tr/pub/cusosbil/issue/32037/353071

Uslu, M. (1999). Resmi eğitim kurumlarında çalışan psikolojik danışma ve rehberlik uzmanlarının iş doyumu ve tükenmişlik düzeylerinin danışmanların denetim odağı ve bazı değişkenlere göre karşılaştırılması [A Comparison of job satisfaction and burnout levels of psychological councelling and guiding professionals working at legal educational institutions according to locus of control and other variables] [Unpublished master's thesis]. Selcuk University.

Usta, Ş. (2017). Rehber öğretmenlerin iş tatmin düzeylerinin demografik değişkenler açısından incelenmesi [Examination of guidance teachers' job satisfaction levels in terms of demographic variables] [Unpublished master's thesis]. Aksaray University.

Worrell, T. (2004). *School psychologists' job satisfaction: Ten years later.* Virginia.

Worrell, T. G., Skaggs, G. E. & Brown, M. B. (2006). School psychologists' job satisfaction: A 22-year perspective in the USA. *School Psychology International, 27*(2), 131-145. https://doi.org/10.1177/0143034306064540

Yeşilyaprak, B. (2001). Rehber öğretmenlerin iş doyumunun yordanması. [Prediction of job satisfaction of counselors*]. Eurasian Journal of Educational Research, 3*(4), 139-143. https://ejer.com.tr/wp-content/uploads/2021/01/ejer_2001-3-4.pdf

Yeşilyaprak, B. (2004). *Eğitimde rehberlik hizmetleri [Guidance services in education]*. Nobel.

Yeşilyaprak, B. (2011). *Mesleki rehberlik ve kariyer danışmanlığı [Vocational guidance and career counseling]*. Pegem.

Yörükoğlu, A. (1993). *Gençlik çağı/ruh sağlığı ve ruhsal sorunlar [Youth/mental health and mental problems]*. Özgur.

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Consequences of Ignoring a Level of Nesting on Design and Analysis of Blocked Three-level Regression Discontinuity Designs: Power and Type I Error Rates

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Consequences of Ignoring a Level of Nesting on Design and Analysis of Blocked Three-level Regression Discontinuity Designs: Power and Type I Error Rates*

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Abstract

Multilevel regression discontinuity designs have been increasingly used in education research to evaluate the effectiveness of policy and programs. It is common to ignore a level of nesting in a three-level data structure (students nested in classrooms/teachers nested in schools), whether unwittingly during data analysis or due to resource constraints during the planning phase. This study investigates the consequences of ignoring intermediate or top level in blocked three-level regression discontinuity designs (BIRD3; treatment is at level 1) during data analysis and planning. Monte Carlo simulation results indicated that ignoring a level during analysis did not affect the accuracy of treatment effect estimates; however, it affected the precision (standard errors, power, and Type I error rates). Ignoring the intermediate level did not cause a significant problem. Power rates were slightly underestimated, whereas Type I error rates were stable. In contrast, ignoring a top-level resulted in overestimated power rates; however, severe inflation in Type I error deemed this strategy ineffective. As for the design phase, when the intermediate level was ignored, it is viable to use parameters from a two-level blocked regression discontinuity model (BIRD2) to plan a BIRD3 design. However, level 2 parameters from the BIRD2 model should be substituted for level 3 parameters in the BIRD3 design. When the top level was ignored, using parameters from the BIRD2 model to plan a BIRD3 design should be avoided.

Keywords: blocked regression discontinuity designs, multilevel models, hierarchical linear models, ignoring a level of nesting, power analysis

Introduction

One fundamental assumption of Ordinary Least Squares (OLS) regression is that observations are conditionally independent. This assumption is violated when errors are not independent of each other (presenting autocorrelation) due to the nesting of observations within organizational structures (Bickel, 2007; Finch & Bolin, 2017; Goldstein, 2011; Hox, 2010; Raudenbush & Bryk, 2002; Snijder & Bosker, 2011). Violation of independence presents challenges to hypothesis testing. It is well known that bias in point estimates is ignorable, but OLS regression produces overly optimistic standard errors, leading to inflated Type I errors (Finch & Bolin, 2017; Singer, 1987; Fox, 1997). Multilevel linear modeling (MLM) is a compelling option for remedying the violation of independent errors when the nesting structure consists of mutually exclusive groups (such as classrooms, teachers, or schools in education systems).

Additionally, MLM allows inspection of more complex research questions. One can study the influence of contextual factors on the outcome of interest (as predictors). One can also study the influence of contextual factors on the estimates of predictors (as moderators). The latter can be translated into substantial research questions on treatment effect heterogeneity and cross-level interactions. In the past 30 years, MLM has been prevalently used in education research to answer substantive research questions owing to rapid advances in its methodology, development of publicly available software, and accessible literature (e.g., Bickel, 2007; Finch & Bolin, 2017; Goldstein, 2011; Hox, 2010; Raudenbush & Bryk, 2002; Snijder & Bosker, 2011, among many others).

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However, the complex structure of the education system presents challenges to data collection efforts. Data collection efforts on all levels of organizations and actors (students, teachers, administrators, schools, and states) are partially hindered by a lack of economic resources, missing administrative records, or researchers' unwitting ignorance. In one scenario, a researcher could collect data from only students, in the other, from students and classrooms/teachers but not schools, yet in another, from students and schools but not classrooms/teachers. In other words, one of the levels in the organizational structure (e.g., classroom/teachers or schools) could be ignored or omitted. The omission of intermediate level (classrooms/teachers) is typical in practice, sometimes due to the absence of administrative records that identify which classroom or teacher the child belongs to (Zhu et al., 2011) or due to simplicity or small sample sizes (Van den Noorthgate et al., 2005). In education, the most common version of ignoring a level of nesting occurs when classroom-level information is ignored. However, variance attributed to the classroom level can exceed that of the school level (Goldstein, 2011; Muthen, 1991), or the magnitude of this variance can be subject-specific. For instance, the proportion of variance in the mathematic achievement attributed to the classroom level is higher than the proportion of variance in the reading achievement compared to the school level variance (Nye et al., 2004; Raudenbush & Bryk, 2002). Despite the possibility of a sizeable proportion of variance attributed to the intermediate level, many empirical studies did not acknowledge classroom level information in the analysis (e.g., Konu et al., 2002; Raudenbush & Bryk, 1986). Some recent evaluation studies indicated that regression discontinuity designs (RDDs) are not exempt from this practice (see Jenkins et al., 2016; Konstantopoulos & Shen, 2016; Luyten, 2006; May et al., 2016). The literature consistently demonstrated that ignoring a top or intermediate level has a detrimental effect on variance components and standard errors (Moerbeek, 2004; Opdenakker & Van Damme, 2000; Van den Noortgate et al., 2005; Zhu et al., 2011). From this point forward, we will refer to level 1 as L1, level 2 as L2, and level 3 as L3.

Effects of Ignoring a Level of Nesting on Variance Components

Using a three-level model (students as L1– classrooms/teachers as L2 – schools as L3), in the case of a balanced design[†], Moerbeek (2004) found that ignoring L3 did not affect the variance component at L1 but inflated the variance component at L2. The inflation in the L2 variance was approximately equal to the ignored amount at L3. Similarly, using a four-level model (students as L1 – teachers as L2 – classrooms as L3 – schools as L4), Van den Noortgate et al. (2005) concluded that omission of L4 did not affect variance components at L2 and L1. However, the ignored variance at L4 was transferred to the variance at L3.

Ignoring an intermediate level is more complicated than ignoring the top level. Van den Noortgate et al. (2005) found that the omission of an intermediate level (L2 or L3 in a four-level model) resulted in inflated variance components at the flanking levels. For example, the variance was distributed to L2 and L4 when L3 was ignored. This finding is in line with Moerbeek (2004) and Opdenakker and Van Damme (2000). Moerbeek (2004) noted that inflation in variance components depended on the magnitude of the variance component at the ignored level, the level at which the predictor variable was measured, and sample sizes at one or more levels.

Effects of Ignoring a Level of Nesting on Standard Errors

The literature has already established that fixed effect estimates are not affected as much when one relies on OLS estimation instead of MLM, whereas standard errors are overly optimistic (Finch & Bolin, 2017; Singer, 1987; Fox, 1997). If one relies on OLS estimation instead of MLM in the face of a multilevel data structure, it implies that all levels of nesting are ignored. When the variance component of a given level is affected due to ignoring a level of nesting, standard errors of the estimates are also affected (Opdenakker & Van Damme, 2000).

In the case of a balanced design, using a three-level model (students as L1– classrooms as L2– schools as L3), Moerbek (2004) found that inflation in standard errors depended on the ignored level (L2 versus L3), the level at which predictor variable was measured, the magnitude of the proportion of variance attributed to the ignored level, and sample sizes at each level. For example, ignoring L2 inflates standard errors for fixed effect estimates at L1, resulting in a loss of power but not those at L3 (Moerbek, 2004). However, as Moerbek (2004) noted, if the proportion of variance attributed to the ignored level was minor, standard errors of fixed effect estimates were not affected to a great extent. This finding was later confirmed by Zhu et al. (2011) using empirical data.

Using a four-level model (students as L1– teachers as L2 - classrooms as L3– schools as level 4), Van den Noortgate et al. (2005) found that, in general, the standard error of the intercept and estimates at the adjacent levels were affected. When level 4 was ignored, the standard error of the estimate for predictors at L3

[†] A balanced design means having the same number of lower-level units per higher-level unit. For example, a balanced two-level design would have *n* number of level 1 units for each level 2 unit.

was affected. When L3 was ignored in balanced data, the standard error of the estimate for predictors at L2 increased. When the data was unbalanced and L3 was ignored, the standard error of the estimates for predictors at level 4 decreased.

Opdenakker and Van Damme (2000) found that regardless of which level is ignored, the standard error of the intercept was underestimated. However, when L4 was ignored, the standard error of the estimates at L1 and L2 was not affected as much. Zhu et al. (2011) extended previous work on ignoring a level of nesting by mainly focusing on the design phase of cluster-randomized trials rather than analysis, although results apply to both. In particular, the authors considered design parameters from two-level data to design three-level studies. Manipulating and analyzing four empirical multi-site datasets (including elementary and secondary school data), Zhu et al. (2011) concluded that ignoring the intermediate level had no substantial effects on statistical power or standard error of the estimate for predictors at the top level. Additionally, they concluded that using design parameters from a two-level model to design a three-level study did not pose a substantial threat to the precision of the treatment effect at the top level.

Evidence from Empirical Studies that Ignore a Level of Nesting in RDD

From 2000 onward, several studies used RDD with a discontinuity at L1. These studies, one way or another, adjusted their estimates for clustering. About a quarter of them used the MLM framework to adjust for clustering (e.g., Hustedt et al., 2015; Luyten, 2006; Luyten et al., 2008; May et al., 2016), and about a quarter of them used Lee and Card (2008) method (e.g., Balu et al., 2015; Cortes, 2015; Deke et al., 2012; Harrington et al., 2016; Reardon et al., 2010). The remaining studies either used bootstrap methods or none (e.g., Jenkins et al., 2016; Klerman et al., 2015; Leeds et al., 2017; Ludwig & Miller, 2005; Matsudarie, 2008; Wong et al., 2008). The four RDDs relying on the individual level cutoff and the MLM framework are summarized below.

Hustedt et al. (2015) evaluated the effectiveness of the Arkansas Better Chance (ABC) initiative at kindergarten on student achievement, relying on the state's strict age-based admission criteria to the program. Although they analyzed the data using a single-level RDD, district-level information was included in the model as fixed effects. Luyten (2006) used Trends in International Mathematics and Science Study (TIMSS) 1995 large-scale assessment data to examine the effect of an extra year of schooling on student achievement, relying on the cutoff that split students into consecutive grades. Similarly, Luyten et al. (2008) used Progress in International Reading Literacy Study (PIRLS) 2000 large-scale assessment data to examine the effect of an extra year of schooling on student achievement, relying on the cutoff that split students into 9^{th} and 10^{th} grades. Luyten (2006) and Luyten et al. (2008) analyzed the data using a two-level RDD model where the effect of an extra year of schooling was assumed to vary across schools randomly. May et al. (2016) evaluated the effectiveness of Reading Recovery i3 Scale-Up on students' achievement in first and third grades relying on students' pretest scores. They analyzed the data using a two-level RDD model where the program effect was assumed to vary across schools randomly. In summary, four RDDs relying on individual level cutoff-based assignment and the MLM framework could have been analyzed by acknowledging the classroom level information (intermediate level) or district or state-level fixed effects (top-level).

Problem Statement

Drawing from four multi-site empirical elementary and secondary school datasets, Zhu et al. (2011) concluded that ignoring the intermediate level did not pose a substantial threat to the design and analysis of three-level cluster-randomized trials. However, scholars in school effectiveness research portray a different picture (Moerbek, 2004; Opdenakker & Van Damme, 2000; van Der Noortgate et al., 2005). Unlike Zhu et al. (2011), these scholars usually focused on the analysis phase. From a design perspective, Zhu et al. (2011) showed that using design parameters from a two-level model (the intermediate level was ignored) is viable for designing a three-level study where the treatment variable is at the top level. Whether these findings can be extended to designs with the L1 treatment variable is unclear. In this study, within the context of blocked three-level RDD design (BIRD3), we investigate whether it is plausible to use parameters from a misspecified blocked two-level RDD design (BIRD2) model (either intermediate or top-level in BIRD3 design is ignored) to plan a future BIRD3 design. Specifically, we investigate the following questions:

1. How do variance components shift when intermediate or top level in a BIRD3 model is ignored?
2. How is the precision of the treatment effect estimate (an L1 predictor) affected by these misspecifications?
3. Can we use design parameters from a misspecified BIRD2 model (where intermediate or top level in BIRD3 design was ignored) to plan a future BIRD3 design?

Method

Consider a sample with three levels of nesting structure (e.g., students as L1 – classrooms as L2 – schools as L3), with an assignment variable S and a predetermined cutoff S_0 at L1 (from which treatment variable T is

derived), a covariate *X* at L1, a covariate *W* at L2, and a covariate *V* at L3. Assume intercept and treatment effect is random across L2 and L3 units. Also, assume that the data is balanced: *n* number of L1 units per L2 unit, *J* number of L2 units per L3 unit, and *K* number of L3 units. Balanced data is not the requirement for the model or the estimation procedure; however, the power rate of the average treatment effect approximates formula-based power rates in the `cosa` R package (Bulus & Dong, 2021a; Bulus & Dong, 2021b) and PowerUp! software (Dong & Maynard, 2013).

Next, we describe statistical models (unconditional, treatment-only, and full models) for the correctly specified BIRD3 model. We also define standardized variance parameters such as intra-class correlation coefficients, R-squared values, and treatment effect heterogeneity. These standardized parameters can be used in subsequent precision calculations (statistical power, minimum required sample size, and minimum detectable effect size). Furthermore, we also describe standardized standard error formulas for the L1 treatment effect in BIRD3 and BIRD2 designs. Standardized standard error formulas require standardized variance parameters as input and provide the basis for precision calculations.

Statistical Models

Unconditional Model

The following unconditional model is used to obtain variance parameters σ^2, τ_2^2, and τ_3^2, as defined below, which will be used to calculate various standardized parameters along with parameters from the full model.

L1: $Y_{ij} = \beta_{0jk} + r_{ijk}$

L2: $\beta_{0jk} = \gamma_{00k} + \mu_{0jk}$

L3: $\gamma_{00k} = \xi_{000} + \varsigma_{00\mathrm{k}}$,

where $r_{ijk} \sim N(0, \sigma^2)$, $\mu_{0jk} \sim N(0, \tau_2^2)$ and $\varsigma_{00\mathrm{k}} \sim N(0, \tau_3^2)$.

Treatment-only Model

The following model is used to obtain variance parameters τ_{T2}^2 and τ_{T3}^2, as defined below, which will be used to calculate various standardized parameters along with parameters from the unconditional and full models.

L1: $Y_{ij} = \beta_{0jk} + \beta_{1jk} T_{ijk} + r_{ijk}$

L2: $\beta_{0jk} = \gamma_{00k} + \mu_{0jk}$

$\beta_{1jk} = \gamma_{10k} + \mu_{1jk}$

L3: $\gamma_{00k} = \xi_{000} + \varsigma_{00\mathrm{k}}$

$\gamma_{10k} = \xi_{100} + \varsigma_{10\mathrm{k}}$,

where $r_{ijk} \sim N(0, \sigma_{|T}^2)$, $\begin{pmatrix}\mu_{0jk}\\ \mu_{1jk}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\tau_{2|T}^2 & \tau_{2T2}\\ \tau_{2T2} & \tau_{T2}^2\end{pmatrix}\right)$ and $\begin{pmatrix}\varsigma_{00\mathrm{k}}\\ \varsigma_{10\mathrm{k}}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\tau_{3|T}^2 & \tau_{3T3}\\ \tau_{3T3} & \tau_{T3}^2\end{pmatrix}\right)$.

Full Model

The following model is used to generate data for Monte Carlo simulations. It is also used to obtain variance parameters $\sigma_{|T,S,X}^2$, $\tau_{2|W}^2$, and $\tau_{3|V}^2$, as defined below, which are used to calculate various standardized parameters along with the parameters from the unconditional and treatment-only model. This model also estimates Monte Carlo-based treatment effect, standard error, and power and Type I error rates for a given scenario.

L1: $Y_{ij} = \beta_{0jk} + \beta_{1jk} T_{ijk} + \beta_{2jk}(S_{ijk} - S_0) + \beta_{3jk} X_{ijk} + r_{ijk}$

L2: $\beta_{0jk} = \gamma_{00k} + \gamma_{01k} W_{jk} + \mu_{0jk}$

$\beta_{1jk} = \gamma_{10k} + \gamma_{11k} W_{jk} + \mu_{1jk}$

$\beta_{2jk} = \gamma_{20k}$

$\beta_{3jk} = \gamma_{30k}$

L3: $\gamma_{00k} = \xi_{000} + \xi_{001} V_k + \varsigma_{00\mathrm{k}}$

$$\gamma_{10k} = \xi_{100} + \xi_{101}V_k + \varsigma_{10k}$$
$$\gamma_{20k} = \xi_{200}$$
$$\gamma_{30k} = \xi_{300}$$
$$\gamma_{01k} = \xi_{010}$$
$$\gamma_{11k} = \xi_{110},$$

where $r_{ijk} \sim N(0, \sigma^2_{|T,S,X})$, $\begin{pmatrix}\mu_{0jk}\\ \mu_{1jk}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\tau^2_{2|W} & \tau_{2T2|W}\\ \tau_{2T2|W} & \tau^2_{T2|W}\end{pmatrix}\right)$ and $\begin{pmatrix}\varsigma_{00k}\\ \varsigma_{10k}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\tau^2_{3|V} & \tau_{3T3|V}\\ \tau_{3T3|V} & \tau^2_{T3|V}\end{pmatrix}\right)$.

Using parameters from unconditional, treatment only, and full models define

$\rho_2 = \frac{\tau_2^2}{\tau_3^2+\tau_2^2+\sigma^2}$, which is the proportion of variance in the outcome between L2 units;

$\rho_3 = \frac{\tau_3^2}{\tau_3^2+\tau_2^2+\sigma^2}$, which is the proportion of variance in the outcome between L3 units;

$\omega_2 = \frac{\tau_{T2}^2}{\tau_2^2}$, which is the treatment effect heterogeneity across L2 units;

$\omega_3 = \frac{\tau_{T3}^2}{\tau_3^2}$, which is the treatment effect heterogeneity across L3 units;

$R_1^2 = 1 - \sigma^2_{|T,S,X}/\sigma^2$, which is the L1 variance explained by L1 variables;

$R_{T2}^2 = 1 - \tau^2_{T2|W}/\tau^2_{T2}$, which is the proportion of variance at L2 on the treatment explained by L2 variables;

$R_{T3}^2 = 1 - \tau^2_{T3|V}/\tau^2_{T3}$, which is the proportion of variance at L3 on the treatment explained by L3 variables.

Next, we provide standardized standard error formulas for treatment effect in BIRD3 and BIRD2 design which are re-parameterized using standardized variance parameters defined above.

Standardized Standard Error for the Correctly Specified BIRD3 Model

For the correctly specified BIRD3 model, standardized standard error of the treatment effect takes the form of (Bulus & Dong, 2022)

$$SE\left(\hat{\xi}_{100}\right) = \sqrt{\frac{\omega_3\rho_3(1-R^2_{T3})}{K} + \frac{\omega_2\rho_2(1-R^2_{T2})}{KJ} + \frac{(1-\rho_3-\rho_2)(1-R^2_1)(RDDE)}{KJnp(1-p)}}$$

where RDDE is the regression discontinuity design effect and takes the form of $RDDE = 1/(1-\rho^2_{TS})$ when the linear form of the score variable is considered (Bulus, 2022; Bulus & Dong, 2022; Schochet, 2008, 2009). ρ^2_{TS} is the squared correlation between treatment and score variables. It is defined as $\rho^2_{TS} = \sigma_{TS}/(\sqrt{p(1-p)\sigma_S})$, where σ_{TS} is the covariance between *T* and *S*, and σ_S is the standard deviation of *S* (see Bulus, 2022; Bulus & Dong, 2022; Schochet, 2008, 2009).

Monte Carlo Simulation

Population Parameters and Scenarios

We generated $S, X, W, V \sim N(0,1)$ and derived T from S and S_0 such that $p = 0.5$ or 0.2. Coefficients were manipulated such that ρ_2 and ρ_3 values are close to those commonly encountered in education settings. The two scenarios that produce different values of ρ_2 and ρ_3 are as follows: Scenario 1 yields $\rho_2 \cong 0.40$ and $\rho_3 \cong 0.20$, and Scenario 2 yields $\rho_2 \cong 0.15$ and $\rho_3 \cong 0.10$ approximately.

Scenario 1

L1: $Y_{ij} = \beta_{0jk} + \beta_{1jk}T_{ijk} + 0.5\left(S_{ijk} - S_0\right) + 0.5X_{ijk} + r_{ijk}$

L2: $\beta_{0jk} = \gamma_{00k} + 0.3W_{jk} + \mu_{0jk}$

$\beta_{1jk} = \gamma_{10k} + 0.3W_{jk} + \mu_{1jk}$

L3: $\gamma_{00k} = 0 + 0.25V_k + \varsigma_{00k}$

$$\gamma_{10k} = \xi_{100} + 0.25V_k + \varsigma_{10k},$$

where $r_{ijk} \sim N(0,1)$, $\begin{pmatrix}\mu_{0jk}\\ \mu_{1jk}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1.5 & 0\\ 0 & 1.5\end{pmatrix}\right)$ and $\begin{pmatrix}\varsigma_{00k}\\ \varsigma_{10k}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1 & 0\\ 0 & 0.5\end{pmatrix}\right)$.

Scenario 2

L1: $Y_{ij} = \beta_{0jk} + \beta_{1jk}T_{ijk} + 0.3(S_{ijk} - S_0) + 0.3X_{ijk} + r_{ijk}$

L2: $\beta_{0jk} = \gamma_{00k} + 0.25W_{jk} + \mu_{0jk}$

$\beta_{1jk} = \gamma_{10k} + 0.25W_{jk} + \mu_{1jk}$

L3: $\gamma_{00k} = 0 + 0.2V_k + \varsigma_{00k}$

$\gamma_{10k} = \xi_{100} + 0.2V_k + \varsigma_{10k},$

where $r_{ijk} \sim N(0,3)$, $\begin{pmatrix}\mu_{0jk}\\ \mu_{1jk}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1.5 & 0\\ 0 & 1\end{pmatrix}\right)$ and $\begin{pmatrix}\varsigma_{00k}\\ \varsigma_{10k}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1 & 0\\ 0 & 0.5\end{pmatrix}\right)$.

Along with the four scenarios (Scenario 1 or 2, by $p = 0.5$ or 0.2) above, we determined treatment effect as $\xi_{100} = 0.25$ for statistical power simulation and as $\xi_{100} = 0$ for Type I error simulation. Additionally, we differed sample size $K = 50$ or 100, and kept $n = 20$ and $J = 5$ constant across all the scenarios. Sample sizes were chosen to approximate those commonly encountered in education. Although $J = 5$ may not be as common, it is an ideal minimum number to obtain consistent variance estimates. In total, there were eight scenarios for statistical power simulation (P1-P8) and eight scenarios for Type I error simulation (T1-T8).

Analysis

We used PROC MIXED in SAS with default restricted maximum likelihood (REML) estimation and unstructured (UN) variance-covariance structure. The data were generated for these eight (P1-P8 and T1-T8) scenarios using parameters described in the equations (see *Monte Carlo Simulation* section). As for the correctly specified model, each generated data set was analyzed using the "Null Model," "Treatment-only Model," and "Full Model." For each scenario, the procedure was replicated 5000 times. Monte Carlo-based standard error (SE_{MC}) was calculated as the standard deviation of the 5000 treatment effect estimates. Monte Carlo-based power and Type I error rates were calculated based on the proportion of replications rejecting the null with a *p*-value smaller than 0.05. Other estimated parameters were averaged over 5000 replications. The standardized parameters are based on averages of 5000 replications. There were 5000 rows for estimates, standard errors, and variance parameters, but only their averages were used to obtain standardized variance parameters.

Power Calculations

Averages of 5000 raw estimates were transformed into standardized parameters according to definitions in the "Null Model," "Treatment-only Model," and "Full Model" described in the earlier section. Then, the standardized parameters were used in `power.bird3()` function in the `cosa` R library (Bulus & Dong, 2021a, 2021b). Model parameters, corresponding arguments, and their possible range are defined in Table 1. There are four combination of power calculations. One could ignore either intermediate or top level in a BIRD3 design, and use L2 parameters obtained from a BIRD2 model for either L2 or L3 parameters in a BIRD3 design.

Table 1. BIRD3 model parameters, corresponding `cosa` R package arguments, and their range

Parameter	$ES = \frac{\xi_{100}}{\sqrt{\tau_3^2 + \tau_2^2 + \sigma^2}}$	$\rho_2 = \frac{\tau_2^2}{\tau_3^2 + \tau_2^2 + \sigma^2}$	$\rho_3 = \frac{\tau_3^2}{\tau_3^2 + \tau_2^2 + \sigma^2}$	$\omega_2 = \frac{\tau_{T2}^2}{\tau_2^2}$	$\omega_3 = \frac{\tau_{T3}^2}{\tau_3^2}$
`power.bird3()`	`es`	`rho2`	`rho3`	`omega2`	`Omega3`
Range	$ES \sim N(0,1)$	[0,1]	[0,1]	[0,1]	[0,1]
Parameter	g_3: number of L3 covariates excluding treatment	$R_1^2 = 1 - \frac{\sigma_{\lvert T,S,X}^2}{\sigma^2}$	$R_{T2}^2 = 1 - \frac{\tau_{T2\lvert W}^2}{\tau_{T2}^2}$	$R_{T3}^2 = 1 - \frac{\tau_{T3\lvert V}^2}{\tau_{T3}^2}$	p: proportion of subjects below (or above) the cutoff
`power.bird3()`	`g3`	`r21`	`r2t2`	`r2t3`	`p`

Range	$g_3 \in N^+$	[0,1]	[0,1]	[0,1]	(0,1)
Parameter	n_1	n_2	n_3		
`power.bird3()`	`n1`	`n2`	`n2`		
Range	$n_1 \in N^+$	$n_2 \in N^+$	$n_3 \in N^+$		

When intermediate level is ignored, and L2 parameters from a BIRD2 model is used for L3 parameters in a future BIRD3 design the following code format is used. Note that L2 parameters in a future BIRD3 design are constrained to zero; thus, `rho2 = 0`, `omega2 = 0`, and `r2t2 = 0`.

```
power.bird3(es = 0.10, rho2 = 0, rho3 = .30, omega2 = 0, omega3 = .54,
            g3 = 1, r21 = 0.22, r2t2 = 0, r2t3 = 0.08,
            p = 0.50, n1 = 20, n2 = 5, n3 = 50)
```

When intermediate level is ignored, and L2 parameters from a BIRD2 model is used for L2 parameters in a future BIRD3 design the following code format is used. Note that L3 parameters in a future BIRD3 design are constrained to zero; thus, `rho3 = 0`, `omega3 = 0`, and `r2t3 = 0`.

```
power.bird3(es = 0.10, rho3 = 0, rho2 = .30, omega3 = 0, omega2 = .54,
            g3 = 0, r21 = 0.22, r2t3 = 0, r2t2 = 0.08,
            p = 0.50, n1 = 20, n2 = 5, n3 = 50)
```

When top level is ignored, and L2 parameters from a BIRD2 model is used for L3 parameters in a future BIRD3 design the following code format is used. Note that L2 parameters in a future BIRD3 design are constrained to zero; thus, `rho2 = 0`, `omega2 = 0`, and `r2t2 = 0`.

```
power.bird3(es = 0.10, rho3 = .61, rho2 = 0, omega3 = .65, omega2 = 0,
            g3 = 1, r21 = 0.53, r2t3 = 0.04, r2t2 = 0,
            p = 0.50, n1 = 20, n2 = 5, n3 = 50)
```

When top level is ignored, and L2 parameters from a BIRD2 model is used for L2 parameters in a future BIRD3 design the following code format is used. Note that L3 parameters in a future BIRD3 design are constrained to zero; thus, `rho3 = 0`, `omega3 = 0`, and `r2t3 = 0` as in the following.

```
power.bird3(es = 0.10, rho2 = .61, rho3 = 0, omega2 = .65, omega3 = 0,
            g3 = 0, r21 = 0.53, r2t2 = 0.04, r2t3 = 0,
            p = 0.50, n1 = 20, n2 = 5, n3 = 50)
```

Results

Results presented in Table 2 answer the *"How do variance components shift when intermediate or top level in a BIRD3 model is ignored?"* question. Table 2 presents unconditional variances for correctly specified BIRD3 and misspecified BIRD2 models. For the correctly specified BIRD3 model, sources of variation in the outcome are attributed to L1 (students), L2 (classrooms), and L3 (schools), denoted as σ^2, τ_2^2, and τ_3^2, respectively. For the misspecified BIRD2 model, sources of variation in the outcome are attributed to L1 (students) and L2 (classrooms or schools), denoted as σ^2 and τ_2^2, respectively. In the misspecified BIRD2 models, one could either ignore the intermediate level for which τ_2^2 refers to the between-school variance or the top level for which τ_2^2 refers to the between-classroom variance. In what follows, we use the term "model" to refer to the analysis model and "design" to refer to the planned model. For example, the "BIRD3 model" refers to the analysis model, whereas the "BIRD3 design" refers to the planned model.

Table 2 demonstrates how variance parameters for the unconditional model shift when intermediate or top level was ignored. The variance of the ignored level was distributed to the flanking levels when the intermediate level was ignored. The variance distributed to the bottom level model was proportionally more (~80%) than the variance distributed to the top level (~%20). The variance of the bottom level remained the same when the top level was ignored. However, variance of the top level in the new BIRD2 model was approximately equal to the sum of L2 and L3 variance in the BIRD3 model. In both cases, the total variance was preserved.

Table 2. Unconditional variance parameters for BIRD3 and misspecified BIRD2 models

Analysis Model	Specification	Parameter	P1	P2	P3	P4	P5	P6	P7	P8
BIRD3	Correctly specified	σ^2	2.15	9.66	2.15	9.66	1.92	9.49	1.92	9.48
		τ_2^2	2.08	1.89	2.07	1.90	1.69	1.64	1.69	1.63
		τ_3^2	1.27	1.21	1.27	1.21	1.11	1.08	1.11	1.08
BIRD2	Intermediate-level is ignored	σ^2	3.83	11.18	3.83	11.19	3.29	10.81	3.29	10.80
		τ_2^2	1.66	1.58	1.67	1.58	1.44	1.39	1.43	1.39
BIRD2	Top-level is ignored	σ^2	2.15	9.66	2.15	9.66	1.92	9.49	1.92	9.48
		τ_2^2	3.32	3.08	3.33	3.10	2.78	2.69	2.79	2.70

The same symbol bears different meanings in different models. σ^2: L1 variance. τ_2^2: L2 variance. τ_3^2: L3 variance. Numbers are averages of 5000 replications.

It is ideal for a researcher to analyze data with three levels of nesting using the BIRD3 model. It is also desirable for a researcher to plan a BIRD3 design using parameters reported in existing scholarly work in which BIRD3 models were utilized. However, it is also possible for a researcher to analyze data with three levels of nesting using the BIRD2 model where either intermediate level (classrooms) or top-level (schools) is ignored. Results presented in Tables 3 to 6 answer the "*How is the precision of the treatment effect estimate (an L1 predictor) affected by these misspecifications?*" question. When the intermediate level is ignored in a BIRD3 model, it becomes a BIRD2 model where the previous third level remains the top level. The variance component of the ignored level is distributed to the new top and bottom levels. The sample size for the top level remains the same (K); however, the sample size for the bottom level is now the combined sample size (nJ). Finally, the degrees of freedom for the test statistic does not change. When the top-level is ignored; however, the variance component at the bottom level does not change, whereas the variance of the ignored level is conveyed to the new top level. The sample size for the new top level is now combined (JK), whereas the sample size for the new bottom level remains the same (n). On the contrary, the degrees of freedom for the test statistic changes due to the increased top-level sample size.

When the intermediate level was ignored, MC simulation results indicated that power rates were slightly underestimated (see Table 3), whereas Type I error rates did not change substantially (see Table 4). In contrast, when the top-level was ignored, power rates were overestimated, and Type I errors were severely inflated. As the top-level sample size is one of the most critical determinants of power, the change in the top-level sample size alone was sufficient to overestimate power (see Table 5). However, Type I error rates were severely inflated (see Table 6). Inflated Type I error rates offset the benefit of having an overpowered model.

The result of the MC simulation for the correctly specified BIRD3 model is provided in Tables 1A and 2A in Appendix A for comparison purposes. There was a close correspondence between MC-based power rates and those calculated via the `cosa` R package (see Table 1A). Type I error rates match the 5% nominal rate (see Table 2A). The tables in the Appendix A provide a baseline for further exploring and comparing power calculations in the following sections.

Table 3. Comparison of power rates from BIRD3 and L2-ignored model

Scenario	P1	P2	P3	P4	P5	P6	P7	P8
MC Power from BIRD3	0.44	0.30	0.74	0.52	0.45	0.26	0.72	0.45
MC Power from BIRD2	0.38	0.28	0.65	0.49	0.38	0.24	0.62	0.42
AD in Powers	-0.07	-0.03	-0.09	-0.03	-0.07	-0.01	-0.10	-0.03
RD in Powers	-15.09	-8.29	-12.05	-5.16	-16.02	-5.53	-13.57	-7.28

AD: Absolute difference. RD: Relative difference (%). Power rates are based on 5000 replications.

Table 4. Comparison of Type I error rates from BIRD3 and L2-ignored model

Scenario	T1	T2	T3	T4	T5	T6	T7	T8
MC Type I Error from BIRD3	0.06	0.06	0.05	0.05	0.05	0.06	0.05	0.05
MC Type I Error from BIRD2	0.05	0.06	0.06	0.05	0.06	0.06	0.05	0.05
AD in Type I Errors	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
RD in Type I Errors	-5.90	2.14	8.95	-4.17	2.19	-2.45	-12.04	-8.65

AD: Absolute difference. RD: Relative difference (%). Type I error rates are based on 5000 replications.

Table 5. Comparison of power rates from BIRD3 and L3-ignored model

Scenario	P1	P2	P3	P4	P5	P6	P7	P8

MC Power from BIRD3	0.44	0.30	0.74	0.52	0.45	0.26	0.72	0.45
MC Power from BIRD2	0.62	0.43	0.86	0.66	0.63	0.34	0.84	0.54
AD in Powers	0.18	0.13	0.12	0.14	0.19	0.08	0.12	0.09
RD in Powers	40.68	43.44	16.00	26.01	41.50	30.66	16.52	20.36

AD: Absolute difference. RD: Relative difference (%). Power rates are based on 5000 replications.

Table 6. Comparison of Type I error rates from BIRD3 and L3-ignored model

Analysis Model	T1	T2	T3	T4	T5	T6	T7	T8
MC Type I Error from BIRD3	0.06	0.06	0.05	0.05	0.05	0.06	0.05	0.05
MC Type I Error from BIRD2	0.15	0.15	0.16	0.14	0.14	0.10	0.14	0.10
AD in Type I Errors	0.09	0.09	0.11	0.09	0.09	0.05	0.09	0.05
RD in Type I Errors	159.03	158.93	208.56	168.94	161.68	79.72	156.20	90.60

AD: Absolute difference. RD: Relative difference (%). Type I error rates are based on 5000 replications.

The results presented earlier were related to the analysis phase. A researcher can use parameters from a misspecified BIRD2 model (assuming intermediate/top level is not available or ignored) to plan a BIRD3 design. Results presented in Tables 7 and 8 answer the "*Can we use design parameters from a misspecified BIRD2 model (either intermediate or top level ignored) to plan a future BIRD3 design?*" question. Table 7 presents the misspecified BIRD2 model where the intermediate level was ignored. Power rates for a future BIRD3 design were calculated considering two cases. In the first case, one can use L2 parameters in the BIRD2 model for L3 parameters in the BIRD3 design (thus, L2 parameters in the BIRD3 design were all constrained to zero). In the second case, one can use L2 parameters in the BIRD2 model for L2 parameters in the BIRD3 design (thus, L3 parameters in the BIRD3 design were all constrained to zero).

When the intermediate level was ignored, considering case (i), calculated power rates slightly underestimated MC-based power rates for the misspecified BIRD2 model (see Table 7). They also underestimated MC-based power rates for the correctly specified BIRD3 model (see Table 1A in Appendix). However, in case (ii), calculated power rates were somewhat optimistic, substantially exceeding MC-based power rates of both BIRD2 and BIRD3 models (see Table 8 and Table 1A in Appendix). On the contrary, when the top-level was ignored, calculated power rates in case (i) were severely underestimated compared to both the BIRD2 model (see Table 8) and BIRD3 models (see Table 1A in Appendix), and in case (ii) they were unstable considering both models. The term "unstable" means we observed no trend regarding the magnitude or direction of the difference from MC-based power rates.

Table 7. Power rates for the misspecified BIRD2 model (L2-ignored)

Scenario	P1	P2	P3	P4	P5	P6	P7	P8
$\hat{\xi}_{100}$	0.24	0.25	0.25	0.25	0.25	0.24	0.25	0.25
$SE(\hat{\xi}_{100})$	0.15	0.18	0.11	0.13	0.15	0.20	0.11	0.14
$ES(\hat{\xi}_{100})$	0.10	0.07	0.11	0.07	0.12	0.07	0.11	0.07
ρ_2	0.30	0.12	0.30	0.12	0.30	0.11	0.30	0.11
ω_2	0.54	0.49	0.53	0.48	0.66	0.57	0.65	0.57
R_1^2	0.22	0.04	0.22	0.04	0.22	0.03	0.22	0.03
R_{2T}^2	0.08	0.07	0.07	0.06	0.07	0.07	0.07	0.06
p	0.50	0.50	0.50	0.50	0.20	0.20	0.20	0.20
ρ_{TS}	0.80	0.80	0.80	0.80	0.70	0.70	0.70	0.70
K	50	50	100	100	50	50	100	100
$SE_{MC}(\hat{\xi}_{100})$	0.15	0.19	0.11	0.13	0.15	0.21	0.11	0.14
MC Power	0.38	0.28	0.65	0.49	0.38	0.24	0.62	0.42
(i) `cosa` R Package (use L2 parameters in the BIRD2 model for L3 parameters in the BIRD3 design)	0.33	0.24	0.67	0.44	0.38	0.22	0.59	0.40
(ii) `cosa` R Package (use L2 parameters in the BIRD2 model for L2 parameters in BIRD3 the design)	0.64	0.33	0.95	0.58	0.73	0.29	0.92	0.53

Results are based on 5000 replications. $\hat{\xi}_{100}$: Treatment effect. SE: Standard Error. ES: Effect size. ρ_2: Proportion of variance in the outcome between L2 units. ω_2: Treatment effect heterogeneity across L2 units. R_1^2: Proportion of variance in the outcome explained by L1 covariates. R_{T2}^2: Proportion of variance in the treatment effect explained by L2 covariates. *p*: Proportion of subjects fall below (or above) cutoff score on the assignment variable. ρ_{TS}: Correlation between the assignment variable and the treatment status. *nJ*: The average number of L1 units per L2 unit was set to 100. *K*: Number of L3 units.

Table 8. Power rates for the misspecified BIRD2 model (L3-ignored)

Scenario	P1	P2	P3	P4	P5	P6	P7	P8
$\hat{\xi}_{100}$	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
$SE(\hat{\xi}_{100})$	0.10	0.14	0.07	0.10	0.11	0.17	0.07	0.12
$ES(\hat{\xi}_{100})$	0.10	0.07	0.11	0.07	0.12	0.07	0.11	0.07
ρ_2	0.61	0.24	0.61	0.24	0.59	0.22	0.59	0.22
ω_2	0.65	0.52	0.65	0.52	0.77	0.60	0.77	0.59
R_1^2	0.53	0.07	0.54	0.07	0.48	0.05	0.48	0.05
R_{2T}^2	0.04	0.05	0.04	0.04	0.04	0.04	0.03	0.04
p	0.50	0.50	0.50	0.50	0.20	0.20	0.20	0.20
ρ_{TS}	0.80	0.80	0.80	0.80	0.70	0.70	0.70	0.70
JK	250	250	500	500	250	250	500	500
$SE_{MC}(\hat{\xi}_{100})$	0.14	0.19	0.10	0.13	0.14	0.20	0.10	0.14
MC Power	0.62	0.43	0.86	0.66	0.63	0.34	0.84	0.54
(i) `cosa` R Package (use L2 parameters in the BIRD2 model for L3 parameters in the BIRD3 design)	0.20	0.20	0.23	0.19	0.23	0.18	0.20	0.18
(ii) `cosa` R Package (use L2 parameters in the BIRD2 model for L2 parameters in the BIRD3 design)	0.61	0.33	0.69	0.33	0.70	0.30	0.62	0.30

Results are based on 5000 replications. $\hat{\xi}_{100}$: Treatment effect. SE: Standard Error. ES: Effect size. ρ_2: Proportion of variance in the outcome between L2 units. ω_2: Treatment effect heterogeneity across L2 units. R_1^2: Proportion of variance in the outcome explained by L1 covariates. R_{T2}^2: Proportion of variance in the treatment effect explained by L2 covariates. *p*: Proportion of subjects fall below (or above) cutoff score on the assignment variable. ρ_{TS}: Correlation between the assignment variable and the treatment status. *n*: The average number of L1 units per L2 unit was set to 20. *JK*: Number of L2 units. AD: Absolute difference. RD: Relative difference.

Discussion

This study investigated the consequences of ignoring either intermediate or top level on variance parameters and precision estimates in blocked three-level regression discontinuity (BIRD3) designs. There are various reasons to employ a misspecified model in this fashion (BIRD2 instead of BIRD3). The intermediate or top level information may be missing, the analysis may be too complex, or the researcher may be unaware of the consequences. Furthermore, BIRD2 models are common in practice; consequently, researchers may have no choice but to use parameters from BIRD2 models to plan for a BIRD3 design.

From an analysis perspective, when the intermediate level was ignored in the BIRD3 model, most of the variance in the ignored level shifted to the new bottom level, and a small portion of the variance shifted to the new top level. These results are in line with Moerbeek (2004), Van den Noortgate et al. (2005), and Opdenakker and Van Damme (2000). The shift in variance components causes a slight underestimation of power rates. It can be neglected if the variance of the intermediate level is small to moderate. This finding is in line with Zhu et al. (2011).

However, classroom-level variance can exceed school-level variance in practice (Goldstein, 2011; Muthen, 1991). One way to decide whether to acknowledge or ignore an intermediate level is to base the modeling decision on the model fit (Opdenakker & Van Damme, 2000). Suppose the chi-square test of difference indicates a substantial difference between the model that ignores and the model that acknowledges the intermediate level. In this case, it is advisable to acknowledge the intermediate level and pursue the analysis accordingly. Another way is to look at the L2 intra-class correlation coefficient. One could ignore the intermediate level if the intra-class correlation coefficient is small.

Since Type I errors did not change substantially when the intermediate level was ignored, one could use parameters from a misspecified BIRD2 model to plan for a BIRD3 design. The deterioration in the power rates will be negligible if L2 parameters in the misspecified BIRD2 model are used for L3 parameters in a future BIRD3 design. The top-level sample size could be oversampled by a few units to compensate for this. However, when L2 parameters of the misspecified BIRD2 model are used for L2 parameters in a future BIRD3 design, the test statistics will be underpowered during analysis. This approach should be avoided.

Ignoring the top level was more problematic, even with a small L3 variance. When the top level was ignored, the variance of the ignored level in the BIRD3 model shifted to the new top level, which is in line with

Moerbeek (2004) and Van den Noortgate et al. (2005). The shift in the variance reduces the power rate substantially; however, the increase in the sample size at the top level often compensates for this loss of power. Regardless, it should be avoided because Type I error rates were severely inflated.

Limitations

Results and their implications are limited to the simulated scenarios. Furthermore, ignoring a level may also mean omitting relevant variables at that level which introduces omitted variable bias. Functional form misspecification is another topic that deserves attention. Bulus (2022) recently found that for balanced RDD designs (p = 0.50), power rates for a linear form of the score variable, linear form interacting with the treatment variable, or quadratic form of the score variable do not change. However, a quadratic form of the score variable interacting with the treatment variable requires a larger sample size to reach the same power rate as the lower polynomial forms. He also found that power rates may differ across different functional form specifications for unbalanced designs (e.g., p = 0.20). In this study, only the linear form of the score variable was considered. The incorrect functional form may complicate misspecification even further.

References

Balu, R., Zhu, P., Doolittle, F., Schiller, E., Jenkins, J., & Gersten, R. (2015). *Evaluation of response to intervention practices for elementary school reading* (NCEE 2016-4000). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. https://files.eric.ed.gov/fulltext/ED560820.pdf

Bickel, R. (2007). *Multilevel analysis for applied research: It's just regression!* Guilford Press.

Bulus, M. (2022). Minimum detectable effect size computations for cluster-level regression discontinuity: Specifications beyond the linear functional form. *Journal of Research on Education Effectiveness, 15*(1), 151-177. https://doi.org/10.1080/19345747.2021.1947425

Bulus, M., & Dong, N. (2021a). Bound constrained optimization of sample sizes subject to monetary restrictions in planning of multilevel randomized trials and regression discontinuity studies. The *Journal of Experimental Education*, *89*(2), 379-401. https://doi.org/10.1080/00220973.2019.1636197

Bulus, M., & Dong, N. (2021b). cosa: Bound constrained optimal sample size allocation. R package version 2.1.0. https://CRAN.R-project.org/package=cosa

Bulus, M., & Dong, N. (2022). Minimum detectable effect size computations for blocked individual-level regression discontinuity: Specifications beyond the linear functional form. *Manuscript in preparation.*

Cortes, K. E., Goodman, J. S., & Nomi, T. (2015). Intensive math instruction and educational attainment long-run impacts of double-dose algebra. *Journal of Human Resources*, *50*(1), 108-158. https://doi.org/10.3368/jhr.50.1.108

Deke, J., Dragoset, L., Bogen, K., & Gill, B. (2012). Impacts of Title I Supplemental Educational Services on student achievement. NCEE 2012-4053. *National Center for Education Evaluation and Regional Assistance*. https://ies.ed.gov/ncee/pubs/20124053/pdf/20124053.pdf

Dong, N., & Maynard, R. (2013). PowerUp!: A tool for calculating minimum detectable effect sizes and minimum required sample sizes for experimental and quasi-experimental design studies. *Journal of Research on Educational Effectiveness*, *6*(1), 24-67. https://doi.org/10.1080/19345747.2012.673143

Finch, W. H., & Bolin, J. E. (2017). *Multilevel modeling using Mplus*. CRC Press.

Fox, J. (1997). A*pplied regression analysis, linear models, and related methods*. Sage Publications.

Goldstein, H. (2011). *Multilevel statistical models* (4th ed). John Wiley & Sons.

Harrington, J. R., Muñoz, J., Curs, B. R., & Ehlert, M. (2016). Examining the impact of a highly targeted state-administered merit aid program on brain drain: Evidence from a regression discontinuity analysis of Missouri's Bright Flight program. *Research in Higher Education*, *57*(4), 423-447. https://doi.org/10.1007/s11162-015-9392-9

Hox, J. J. (2010). *Multilevel analysis: Techniques and applications* (2nd ed). Routledge.

Hustedt, J. T., Jung, K., Barnett, W. S., & Williams, T. (2015). Kindergarten readiness impacts of the Arkansas Better Chance State Prekindergarten Initiative. *The Elementary School Journal*, *116*(2), 198-216. https://doi.org/10.1086/684105

Jenkins, J. M., Farkas, G., Duncan, G. J., Burchinal, M., & Vandell, D. L. (2016). Head Start at ages 3 and 4 versus Head Start followed by state Pre-K which is more effective? *Educational Evaluation and Policy Analysis*, *38*(1), 88-112. https://doi.org/10.3102%2F0162373715587965

Klerman, J. A., Olsho, L. E., & Bartlett, S. (2015). Regression discontinuity in prospective evaluations: The case of the FFVP evaluation. *American Journal of Evaluation*, *36(*3), 403-416. https://doi.org/10.1177%2F1098214014553786

Konstantopoulos, S., & Shen, T. (2016). Class size effects on mathematics achievement in Cyprus: Evidence from TIMSS. *Educational Research and Evaluation*, *22*(1-2), 86-109. https://doi.org/10.1080/13803611.2016.1193030

Konu, A. I., Lintonen, T. P., & Autio, V. J. (2002). Evaluation of well-being in schools–a multilevel analysis of general subjective well-being. *School Effectiveness and School Improvement, 13*(2), 187-200. https://doi.org/10.1076/sesi.13.2.187.3432

Leeds, D. M., McFarlin, I., & Daugherty, L. (2017). Does student effort respond to incentives? Evidence from a guaranteed college admissions program. *Research in Higher Education*, *58*(3), 231-243. http://dx.doi.org/10.1007/s11162-016-9427-x

Ludwig, J., & Miller, D. L. (2005). *Does Head Start improve children's life chances? Evidence from a regression discontinuity design* (No. w11702). National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w11702/w11702.pdf

Luyten, H. (2006). An empirical assessment of the absolute effect of schooling: Regression-discontinuity applied to TIMSS-95. *Oxford Review of Education, 32*(3), 397-429. https://doi.org/10.1080/03054980600776589

Luyten, H., Peschar, J., & Coe, R. (2008). Effects of schooling on reading performance, reading engagement, and reading activities of 15-year-olds in England. *American Educational Research Journal*, *45*(2), 319-342. https://doi.org/10.3102%2F0002831207313345

Matsudaira, J. D. (2008). Mandatory summer school and student achievement. *Journal of Econometrics*, *142*(2), 829-850. https://doi.org/10.1016/j.jeconom.2007.05.015

Manatunga, A. K., Hudgens, M. G., & Chen, S. (2001). Sample size estimation in cluster randomized studies with varying cluster size. *Biometrical Journal*, *43*(1), 75-86. http://dx.doi.org/10.1002/1521-4036(200102)43:1%3C75::AID-BIMJ75%3E3.0.CO;2-N

May, H., Sirinides, P. M., Gray, A., & Goldsworthy, H. (2016). *Reading recovery: An evaluation of the four-year i3 scale-up*. Philadelphia: Consortium for Policy Research in Education. https://files.eric.ed.gov/fulltext/ED593261.pdf

Moerbeek, M. (2004). The consequence of ignoring a level of nesting in multilevel analysis. *Multivariate Behavioral Research, 39*(1), 129-149. https://doi.org/10.1207/s15327906mbr3901_5

Muthén, B. O. (1991). Multilevel factor analysis of class and student achievement components. *Journal of Educational Measurement*, *28*(4), 338-354. http://www.jstor.org/stable/1434897

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis*, *26*(3), 237-257. https://doi.org/10.3102%2F01623737026003237

Opdenakker, M. C., & Van Damme, J. (2000). The importance of identifying levels in multilevel analysis: An illustration of the effects of ignoring the top or intermediate levels in school effectiveness research. *School Effectiveness and School Improvement, 11*(1), 103-130. https://doi.org/10.1076/0924-3453(200003)11:1;1-A;FT103

Raudenbush, S., & Bryk, A. S. (1986). A hierarchical model for studying school effects. *Sociology of Education*, *59*(1), 1-17. https://doi.org/10.2307/2112482

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed). Sage Publications.

Reardon, S. F., Arshan, N., Atteberry, A., & Kurlaender, M. (2010). Effects of failing a high school exit exam on course-taking, achievement, persistence, and graduation. *Educational Evaluation and Policy Analysis*, *32*(4), 498-520. https://doi.org/10.3102%2F0162373710382655

Schochet, P. Z. (2008). *Technical methods report: Statistical power for regression discontinuity designs in education evaluations* (NCEE 2008-4026). National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. https://files.eric.ed.gov/fulltext/ED511782.pdf

Schochet, P. Z. (2009). Statistical power for regression discontinuity designs in education evaluations. *Journal of Educational and Behavioral Statistics*, *34*(2), 238-266. https://doi.org/10.3102%2F1076998609332748

Snijders, T. A., & Bosker, R. J. (2011). *Multilevel analysis: An introduction to basic and advanced multilevel modeling* (2nd ed). Sage Publications.

Singer, J. (1987). An intraclass correlation for analyzing multilevel data. *Journal of Experimental Education*, *55*(4), 219-228. https://doi.org/10.1080/00220973.1987.10806457

Van den Noortgate, W., Opdenakker, M. C., & Onghena, P. (2005). The effects of ignoring a level in multilevel analysis. *School Effectiveness and School Improvement*, *16*(3), 281-303. https://doi.org/10.1080/09243450500114850

Wong, V. C., Cook, T. D., Barnett, W. S., & Jung, K. (2008). An effectiveness-based evaluation of five state pre-kindergarten programs. *Journal of Policy Analysis and Management*, *27*(1), 122-154. https://doi.org/10.1002/pam.20310

Zhu, P., Jacob, R., Bloom, H., & Xu, Z. (2011). Designing and analyzing studies that randomize schools to estimate intervention effects on student academic outcomes without classroom-level information. *Educational Evaluation and Policy Analysis*, *34*(1), 45-68. https://doi.org/10.3102%2F0162373711423786

Appendix A

Table 1A. Power rates for the correctly specified BIRD3 model

Scenario	P1	P2	P3	P4	P5	P6	P7	P8
$\hat{\xi}_{100}$	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
$SE(\hat{\xi}_{100})$	0.14	0.18	0.10	0.13	0.14	0.19	0.10	0.14
$ES(\hat{\xi}_{100})$	0.10	0.07	0.11	0.07	0.12	0.07	0.11	0.07
ρ_2	0.38	0.15	0.38	0.15	0.36	0.13	0.36	0.13
ρ_3	0.23	0.09	0.23	0.09	0.23	0.09	0.23	0.09
ω_2	0.77	0.57	0.77	0.56	0.90	0.64	0.91	0.65
ω_3	0.47	0.47	0.46	0.46	0.54	0.52	0.52	0.52
R_1^2	0.53	0.07	0.54	0.07	0.48	0.05	0.48	0.05
R_{T2}^2	0.06	0.07	0.06	0.06	0.05	0.07	0.05	0.06
R_{T3}^2	0.13	0.11	0.11	0.09	0.13	0.14	0.11	0.09
p	0.50	0.50	0.50	0.50	0.20	0.20	0.20	0.20
ρ_{TS}	0.80	0.80	0.80	0.80	0.70	0.70	0.70	0.70
K	50	50	100	100	50	50	100	100
$SE_{MC}(\hat{\xi}_{100})$	0.14	0.18	0.10	0.13	0.14	0.20	0.10	0.14
MC Power	0.44	0.30	0.74	0.52	0.45	0.26	0.72	0.45
Power from `cosa` R Package	0.42	0.26	0.73	0.48	0.44	0.25	0.72	0.45

Note. Results are based on 5000 replications. $\hat{\xi}_{100}$: Treatment effect. SE: Standard Error. ES: Effect size. ρ_2: Proportion of variance in the outcome between L2 units. ρ_3: Proportion of variance in the outcome between L3 units. ω_2: Treatment effect heterogeneity across L2 units. ω_3: Treatment effect heterogeneity across L3 units. R_1^2: Proportion of variance in the outcome explained by L1 covariates. R_{T2}^2: Proportion of variance in the treatment effect explained by L2 covariates. R_{T3}^2: Proportion of variance in the treatment effect explained by L3 covariates. *p*: Proportion of subjects fall below (or above) cutoff score on the assignment variable. ρ_{TS}: Correlation between the assignment variable and the treatment status. *n*: Average number of L1 units per L2 units, which was set to 20. *J*: Average number of L2 units per L3 units, which was set to 5. *K*: Number of L3 units.

Table 2A. Type I error rates for the correctly specified BIRD3 model

Scenario	T1	T2	T3	T4	T5	T6	T7	T8
$\hat{\xi}_{100}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
$SE(\hat{\xi}_{100})$	0.14	0.18	0.10	0.13	0.14	0.19	0.10	0.14
$ES(\hat{\xi}_{100})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ρ_2	0.39	0.15	0.39	0.15	0.36	0.13	0.36	0.13
ρ_3	0.23	0.10	0.23	0.10	0.24	0.09	0.24	0.09
ω_2	0.77	0.57	0.77	0.56	0.90	0.64	0.91	0.65
ω_3	0.47	0.47	0.46	0.46	0.54	0.52	0.53	0.52
R_1^2	0.51	0.06	0.51	0.06	0.46	0.05	0.46	0.05
R_{T2}^2	0.06	0.07	0.06	0.06	0.05	0.07	0.05	0.06
R_{T3}^2	0.13	0.10	0.11	0.09	0.13	0.13	0.12	0.10
p	0.50	0.50	0.50	0.50	0.20	0.20	0.20	0.20
ρ_{TS}	0.80	0.80	0.80	0.80	0.70	0.70	0.70	0.70
K	50	50	100	100	50	50	100	100
$SE_{MC}(\hat{\xi}_{100})$	0.14	0.18	0.10	0.13	0.14	0.20	0.10	0.14
MC Type I Error	0.06	0.06	0.05	0.05	0.05	0.06	0.05	0.05
Type I Error from `cosa` R Package	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Results are based on 5000 replications. $\hat{\xi}_{100}$: Treatment effect. SE: Standard Error. ES: Effect size. ρ_2: Proportion of variance in the outcome between L2 units. ρ_3: Proportion of variance in the outcome between L3 units. ω_2: Treatment effect heterogeneity across L2 units. ω_3: Treatment effect heterogeneity across L3 units. R_1^2: Proportion of variance in the outcome explained by L1 covariates. R_{T2}^2: Proportion of variance in the treatment effect explained by L2 covariates. R_{T3}^2: Proportion of variance in the treatment effect explained by L3 covariates. *p*: Proportion of subjects fall below (or above) cutoff score on the assignment variable. ρ_{TS}: Correlation between the assignment variable and the treatment status. *n*: Average number of L1 units per L2 units, which was set to 20. *J*: Average number of L2 units per L3 units, which was set to 5. *K*: Number of L3 units.