

A Mobile Based Activity Recommendation System for Autism Patients

Aidin Bazarchi

Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Computer Engineering

Eastern Mediterranean University
April 2019
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

Prof. Dr. Ali Hakan Ulusoy
Acting Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science in Computer Engineering.

Prof. Dr. Işık Aybay
Chair, Department of Computer
Engineering

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Computer Engineering.

Assoc. Prof. Dr. Duygu Çelik
Ertuğrul
Supervisor

Examining Committee

1. Assoc. Prof. Dr. Duygu Çelik Ertuğrul

2. Asst. Prof. Dr. Yıldıran Bitirim

3. Asst. Prof. Dr. Mehtap Köse Ulukök

ABSTRACT

Today, specialists and governments dealing with Pervasive Development Disorder (PDD) are trying to minimize the experienced problems of the individuals with educational methods chosen carefully after extensive research. However, because of various reasons the families of those who cannot reach these organizations are trying to give appropriate education at home. During these trainings while selecting the educational methods, the families prefer Internet and related software solutions. Recently, many mobile applications are available in mobile applications markets about PDD education. The thesis is about developing a mobile application recommendation system to suggest most appropriate mobile applications of the PDD children to help their families in their children education. Most important PDD recently seen is Autism Spectrum Disease (ASD) which is the target audience for our thesis. However, they have different functionalities and purposes for educating the children with ASD such as; build fine motor skills, develop interactive skills etc. via mobile applications. The aim of this thesis are: (1) develop insufficient skills of the children with ASD through appropriate mobile applications and physical activities, (2) support ASD specialist or teachers to send appropriate tests for their students through system functions and get answers from parents' mobiles and follow the analysis of results, (3) find special educational mobile applications in mobile markets to support parents and specialties during education of children with ASD, (4) support parents by suggesting appropriate educational mobile applications and physical activities as homework.

Keywords: Autism Spectrum Disease, Recommendation Systems, Education, E-learning, Mobile Applications.

ÖZ

Yaygın Gelişme Bozukluğu (YGB) ile ilgilenen uzmanlar ve hükümetler, geniş kapsamlı araştırmalardan sonra özenle seçilmiş eğitim yöntemlerini kullanarak, günümüzde bireylerin yaşadığı sorunları en aza indirme hedefindedir. Ancak, çeşitli nedenlerden dolayı bu kuruluşlara ulaşamayan aileler, genelde YGB bozukluğu olan çocuklarına evde uygun eğitimi vermeye çalışıyorlar. Bu eğitimler sırasında eğitim yöntemlerini seçerken, aileler interneti ve ilgili yazılım çözümlerini kullanmayı tercih ediyorlar. Tez konusu, YGB çocuklu ailelere çocuklarının eğitiminde yardımcı olacak en uygun mobil uygulamalarını önermek için, bir mobil uygulama öneri sistemi geliştirmek üzerinedir. Son zamanlarda, en yaygın YGB türü olan ve tezin hedef kitlesi olan Otizm Spektrum Hastalığı (OSH) 'dır. Ancak, uygulamada OSH'li çocukları eğitmek için farklı yaklaşımlar ve amaçlar vardır, örneğin; mobil uygulamalar aracılığıyla çocukların motor beceriler geliştirmek, karşılıklı iletişim becerilerini geliştirmek vb. Bu tezin amacı: (1) uygun mobil uygulamalar ve fiziksel aktivite önerileri ile OSH'li çocukların yetersiz becerilerini geliştirmek, (2) OSH uzmanına veya öğretmenlerine, bireyler için sistem fonksiyonları aracılığıyla uygun testler gönderme ve ebeveynlerin cep telefonlarından cevap alma ve sonuçların analizini takip etme konusunda destek vermek, (3) OSH'li çocukların eğitimi sırasında ebeveynleri ve öğretmenleri desteklemek için mobil pazarlardaki özel eğitici mobil uygulamaları bulmak, (4) uygun eğitim amaçlı mobil uygulamalar ve fiziksel aktiviteler ev ödevi gibi önererek ebeveynlerin bilgilerini destekler.

Anahtar Kelimeler: Otizm Spektrum Hastalığı, Öneri Sistemleri, Eğitim, E-öğrenme, Mobil Uygulamalar.

DEDICATION

To my father Rasoul Bazarchi.

To my mother Vida Saffari.

To my brothers Armin, Arman.

ACKNOWLEDGMENT

I always thankful from god for all the helps. Special thanks to my supervisor Assoc. Prof. Dr. Duygu elik Ertuđrul for her amazing patient, ideas, knowledge's and best advices that put me on the right road on writing my thesis. I also want to thankful from Special Education Expert Ozlem Tiryakioglu for all the helps, information and advices which helps us to build this system.

TABLE OF CONTENTS

ABSTRACT	iii
ÖZ	iv
DEDICATION.....	v
ACKNOWLEDGMENT	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xiii
1 INTRODUCTION	1
2 LITERATURE REVIEW	3
2.1 Literature Survey.....	3
2.2 DSM-5 Assessment: An Approach for Pervasive Development Disorders	5
2.2.1 DSM-5 Classification	7
2.2.2 Approach to Clinical Case Formulation	7
2.2.3 DSM-5 Assessment Measures.....	8
2.3 Recent Mobile Platforms.....	13
3 SYSTEM ARCHITECTURE AND FUNCTIONALITY.....	14
3.1 System Data Design	15
3.2 System Functionalities	17
3.2.1 Stage A: Manage by Autism Specialist	21
3.2.2 Stage B: Relation between Web Panel and Web Services.....	21
3.2.3 Stage C: Relation Between Web Service and Database	22
3.2.4 Stage D: Relation Between Parent and Mobile Application.....	22
3.2.5 Stage E: Relation Between Mobile Application Web Services	22

3.2.6 Stage F: Request Evaluates by Web Services	22
3.2.7 Stage G: Storing Data in Database	22
3.2.8 Stage H: How Mobile Application Gets Data.....	22
3.2.9 Stage I: Result Evaluation.....	22
3.2.10 Stage J: Parent Can Check the Statistical Result of Assessment	23
3.2.11 Stage K: Parent and Child	23
3.3 Used Tools	23
3.4 Databases of System Developed	24
3.5 Web Services of System Developed	28
3.6 Web Panel of System Developed.....	28
3.7 Mobile Application of System Developed	29
3.8 Assessment Functions Considered in Developed System	30
4 IMPLEMENTATION	33
4.1 Web Panel Modules	34
4.2 Mobile Application Modules	48
5 EXPERIMENTAL RESULTS	60
5.1 Experimental Setup	60
6 CONCLUSION.....	73
REFERENCES	75
APPENDICES	79
Appendix A: DMS-5 Evaluation	80
Appendix B: MEB Evaluation.....	91

LIST OF TABLES

Table 1. DSM-5 Level 1 Cross-Cutting Symptom Questions.....	9
Table 2. Crucial Stages of Proposed System.....	21
Table 3. Used Tools.	23
Table 4. Web Panel Sections.	29

LIST OF FIGURES

Figure 1. System Architecture of Proposed System.	15
Figure 2. Processes and Actor Activities in the Proposed System	20
Figure 3. E-R Diagram.....	27
Figure 4. Mobile Application Navigation Sketch.....	30
Figure 5. Game Suggestion.	31
Figure 6. Category Score Calculation from Questions Score	32
Figure 7. Login Page Web Panel	34
Figure 8. Home Page Web Panel.....	35
Figure 9. Add Category Web Panel	36
Figure 10. Add Applications Web Panel	37
Figure 11. Add Applications Web Panel Edit Games	38
Figure 12. Add Question Web Panel	39
Figure 13. Add Question Tag Web Panel	39
Figure 14. Assign Question Web Panel	40
Figure 15. Add Activity Web Panel.....	41
Figure 16. Add Activity Tag Web Panel.....	41
Figure 17. Assign Activities Web Panel	42
Figure 18. Student Screen	43
Figure 19. Statistics Screen	44
Figure 20. Question Assigned Screen.....	44
Figure 21. Activity Assigned Screen	45
Figure 22. Share Questions Screen.....	45
Figure 23. Notification Screen Web Panel.....	46

Figure 24. Shared Question Screen.....	47
Figure 25. AppCenter Dashboard Autism Application.....	48
Figure 26. AppCenter Download link.....	48
Figure 27. Mobile Application Tabs.....	49
Figure 28. Choose Language Screen Mobile Application	49
Figure 29. Home Page Mobile Application	50
Figure 30. Game List Mobile Application	50
Figure 31. Games Detail Information Mobile Application	51
Figure 32. Assessment Scream.....	52
Figure 33. Question.....	52
Figure 34. Result Screen Mobile Application	53
Figure 35. Tabs in Result base on categories	54
Figure 36. Games in Result	55
Figure 37. Activities in Result.....	54
Figure 38. Evaluation Results of Assigned Questions	55
Figure 39. Activities Screen	56
Figure 40. Activity detail screen.....	56
Figure 41. Share Screen	57
Figure 42. Add Message	57
Figure 43. Answering the Shares.....	58
Figure 44. Profile Tab	59
Figure 45. Create Profile	59
Figure 46 Setting Screen	59
Figure 47. Assessment Section in Mobile application.....	60
Figure 48. Evaluation Results of Assigned Questions to Parents.....	66

Figure 49. Result Statistics of Questions.	67
Figure 50. Statistics on Mobile Application.....	68
Figure 51. Mobile Application Detail Information Base on Categories	69
Figure 52. Assigned-Question Screen in Admin Panel	70
Figure 53. Mobile Application Activities Assigned Screen.....	71

LIST OF ABBREVIATIONS

ADS	Autism Spectrum Disease
APA	American Psychiatric Association
ARC	Autism Resource Center
BMJ	British Medical Journal
CDC	Centers for Disease Control
DSM	Diagnostic and Statistical Manual of Mental Disorders
EMBC	Engineering in Medicine and Biology Society
HTML	Hypertext Markup Language
ICD	International Classification of Disease
PDD-NOS	Pervasive Developmental Disorder Not Otherwise Specified
PHP	Hypertext Preprocessor
WHODAS	World Health Organization Disability Assessment Schedule
WHO	World Health Organization
WS	Web Service

Chapter 1

INTRODUCTION

Autism Spectrum Disease (ASD) is a sort of pivotal neurodevelopmental issue in cerebrum with deep rooted effects [1]. By and large, ASD shows verbal and non-verbal correspondence issues, for example, troubles in revealing to individuals, things, occasions. Furthermore, steady body developments or practices are ordinarily seen from the general population who have been determined to have ASD [1]. Regardless of whether those are deciding standards by the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) [2], the turmoil changes from individual to individual, in seriousness and mixes of side effects and there is anything but a medicinal test that can analyze it [2]. In 2014, the Centers for Disease Control and Prevention (CDC) has discharged an examination that discovered that 1 of every 68 youngsters matured 8 years had ASD in different networks in the United States [3]. In Portugal, the commonness of ASD in 2007 assessed 10 for each 10,000 youngsters [4]. In spite of the fact that there is still no solution for ASD, is realized that early detection and intercession can enhances youngster's improvement. That is the reason treatment and a day by day preparing and bolster from parents can essentially enhance the desire for the malady [2].

Children with ASD frequently require outer inspiration to start, keep up, or end a movement [5]. Innovative rise gave gadgets the ability to bring visual, material and workman criticism, which can be utilized for youngsters with ASD since this sort of

inspirations are commonly preferable impact over human inspirations [5]. The aim of this system is to meet the increasing needs of autistic children with the help of technology by taking into account the existence of limited solutions

The level of people with ASD who can live with no assistance is low, the greater part of them require loads of aides throughout their life. However, it's settled that, if they have access to appropriate resource and support, they can be in society properly, developing their quality of life, achieve a greater degree of autonomy. Due to these reasons, the system proposed aims to improve the quality of life of the Children with ASD and increase autonomy as much as possible with the use of the latest technologies in mobile devices such as smartphones and tablets [6]. Computer games have been progressively mediated via iPods, smartphones and tablet devices. One of the benefits of tablet devices, besides letting users to use multi-touch and gestures to get rapid device evaluation, is the potential to use the device to employ more than one user at a time in a social context [7]. Literature studies suggest that computer-assisted guidance absorb multimedia elements, and particularly, visually-rich elements, can be useful to engage and adequately teach children with ASD [8].

The proposed system performs a semi-automates assessment especially for the children with ASD, that assesses the recent developments of children classroom via predefined evaluation questions to suggest proper educational activities and mobile platform games in the markets base on the result of questions.

Chapter 2

LITERATURE REVIEW

2.1 Literature Survey

Autism is a confusion which begins to develop in the children at first ages. At the time which brain begin to create, there are heaps of troubles for children with ASD to learn and enhance their capacities, for example learning, correspondence and social aptitudes like a typical one. ASD additionally incorporates Asperger's disorder, Childhood disintegrative confusion and Pervasive Developmental Disorder not Otherwise Specified (PDD-NOS) [9].

Social association and correspondence challenges, repetitive behavior is considered the common symptoms of autism. Despite the fact that the fix of autism isn't found yet, the early examination can exceptionally accommodate and enhances children's condition [10].

Autism populace is on the ascent, the prominence of ASD builds each year 10% to 17% [11]. United States, China, South Korea are the nations with a most astounding rate of autism [11] [12]. In the United States, the rate is 1 in every 68 kids. Also, young men are more influenced than young ladies. Autism is likewise found in Asia, Europe and different locales [13]. In any case, in developing countries, the precise insights aren't available, and the assets are elusive.

In order to identify children with ASD, early assessment is necessary, which needs diagnosis for confirmation. For assessment, different tools are used. These assessment tools originally find the symptoms of ASD and then for confirmation the child must be checked by a teacher or specialist. There are a number of assessment tools that are developed on different kinds of autism [14] [15].

Various appraisal applications have been produced that suit existing apparatuses to evaluation autism consequently. These are generally savvy gadget or electronic applications [16] [17]. A mechanical framework is likewise created to evaluation autism naturally [18]. In any case, unique applications are created, until today no application can guarantee intelligent just as productive appraisal with clinical approval.

The procedure of autism assessment and confirmation is costly and protracted. Therefore, in developed countries, parent use assessment tools to initially check awareness to autism. However, in developing countries people are not well-aware of autism as well as these tools. Therefore, most often ASD remains undetected. For this reason, assessment tools have been developed for children of different age group. Moreover, the social behavior, culture, customs and traditions varies from country to country. Depending on these factors, assessment tools have also been developed based on localization. Also, the lack of awareness, resources and services make autism detection delayed. Therefore, automatic assessment and confirmation is necessary to establish autism detection and mediation.

2.2 DSM-5 Assessment: An Approach for Pervasive Development Disorders

The American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders (DSM) [1] is a categorization of mental disorders with associated principle created to assist the progress of diagnoses of these disorders. With following editions over the past 60 years, it has become an approved reference for clinical usual procedure in the mental health field. Since an entire description of the fundamental pathological method is not possible for most mental disorders, it is valuable to indicate that the current diagnostic criteria are the most excellent ready for use description of how mental disorders are articulate and can be acknowledged by educated clinicians.

The APA initially distributed a starter of DSM in 1844, as a factual order of institutionalized mental patients. It was made to improve correspondence about the sorts of patients thought about in these doctor's facilities. This pioneer to DSM additionally was utilized as a piece of the full U.S list. After World War II, DSM advance through four noteworthy versions into a demonstrative characterization framework for specialists, different doctors, and other emotional wellness experts that clarified the urgent highlights of the full scope of mental issue. The present release, DSM-5, expands on the reason for its precursors (most as of late, DSM-IV-TR, or Text Revision, distributed in 2000) of getting ready guidelines for conclusions that can exhort treatment and the board choices [1].

DSM has been utilized by clinicians and analysts from various headings (natural, psychodynamic, psychological, conduct, relational, family/frameworks), every one of them strive for a typical dialect to give or trade the vital qualities of mental issue

displayed by their patients. The truth of the matter is of incentive to all specialists related with various states of psychological well-being care, including therapists, different doctors, analysts, social laborers, medical attendants, advocates, criminological and lawful authorities, word related and recovery advisors, and other wellbeing experts. DSM-5 is additionally an instrument for amassing and imparting nitty gritty general wellbeing measurements on mental turmoil bleakness and death rates. At last, the criteria and equal content help as a course reading for understudies from the get-go in their vocation who require a systematic method to learn and analyze mental scatters just as for experienced experts identify rare clutters out of the blue [1].

The foundation of the fifth version of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) was a huge endeavor that intricate many individuals progressing in the direction of a typical point over a 12-year advancement. Contemplations and theories were associated with assessing the analytic criteria, thinking about the association of each frame of mind of the manual, and structure new highlights respect to be most valuable to clinicians.

DSM-5 is prepared for use as an online membership at www.PsychiatryOnline.org just as an eBook. The online parts incorporate components and appraisal devices to enhance the symptomatic criteria and content. Additionally, accessible online is a complete arrangement of assistant reference just as additional useful data. The authoritative diagram of DSM-5, its utilization of dimensional measures will let it to be rapidly adaptable to future logical revelations and purgation in its clinical administration. DSM-5 will be look at and decide after some time to consistently assess its adequacy and enhance its incentive to clinicians.

2.2.1 DSM-5 Classification

DSM-5 covers lots of different categories for mental disorder which each of them has different specifications and subcategories. Categories differentiate with DSM-5 codes and the detailed about specification explained completely in the book.

2.2.2 Approach to Clinical Case Formulation

This methodology is intended to give a practical model to utilizing DSM-5, explicitly in clinical utilization. The essential objective of DSM-5 is to help prepared clinicians in the determination of their patients' psychological issue as a bit of appraisal definition which prompts a totally educated treatment to conspire for every person.

The definition record for some random ASD children must incorporate a precise clinical history and a brief outline of the social, mental, and natural perspectives which may have given to grow a given mental confusion. Along these lines, it isn't sufficient to just mark off the side effects in the demonstrative criteria to make a psychological issue determination. Be that as it may, an orderly check for the accessibility of these criteria as they apply to every ASD child will vouch for a trustier appraisal, the relative power, and limit of individual criteria and their offer to a finding require clinical judgment. The side effects in these symptomatic criteria are a segment of the generally constrained gathering of human passionate replication to inside and outer anxieties that are ordinarily held in a homeostatic parity without an infraction in ordinary working. It involves clinical preparing to recognize when the blend of grade, quicken, keep up, and guarding factors have brought about a psychopathological situation in which physical signs and side effects outperform ordinary circle. The last objective of a clinical case detailing is to utilize the prepared to utilize relevant and analytic data in building up an all-inclusive treatment plan that knows by the person's social and social setting. Be that as it may, recommendations for the choice and utilization of the most

helpful proof-based treatment choices for each turmoil are past the area of this manual [1].

2.2.3 DSM-5 Assessment Measures

A dimensional methodology depends upon by and large on a person's unique reports of side effect encounters together with the clinician's understanding is sensible with current symptomatic everyday practice. It is foreseen that as our appreciation of fundamental sickness components dependent on pathophysiology, neurocircuitry, quality condition associations, and research center tests expands, approaches that blend both goal and abstract ASD children information will be reached out to enhance and enhance the sureness of the indicative procedure. Cross-cutting manifestation estimates structured on normal prescription's audit of frameworks can help as a methodology for examining requesting psychopathological areas. The basic restorative audit of frameworks is basic to find sensitive changes in different device frameworks that can encourage conclusion and treatment [1].

The cross-cutting measures have two dimensions: Level 1 questions are a short study of 13 side effect classes for grown-up patients and 12 classifications for youngster and preadult patients. Level 2 questions give a more inside and out evaluation of specific classes. These measures were made to be managed both at essential meeting and after some time to follow the patient's manifestation status and reaction to treatment [1].

The classifications identified with preadult ASD children for child age 6–17. As with the cross-cutting symptom measures, these measures were created to be administered both at primarily interview and over time to track the intensity of the individual's disorder and response to treatment [1]. Table 1 indicates test questions identified with

Parent/Guardian-Rated DSM-5 Level 1 Cross-Cutting Symptoms for child age 6–17

[1].

Table 1. DSM-5 Level 1 Cross-Cutting Symptom Questions.

	Mental Category	During the past TWO (2) WEEKS, how much (or how often) has your child suffering from below problems.	None Not at all	Slight Rare, less than a day or two	Mild Several days	Moderate More than half the days	Severe Nearly every day
Somatic symptoms	1	Complained of stomachaches, headaches, or other aches and pains?	0	1	2	3	4
	1	Said he/she was worried about his/her health or about getting sick?	0	1	2	3	4
Sleep problems	2	Had problems sleeping—that is, trouble falling asleep, staying asleep, or waking up too early?	0	1	2	3	4
Inattention	3	Had problems paying attention when he/she was in class or doing his/her homework or reading a book or playing a game?	0	1	2	3	4
Depression	4	Had less fun doing things than he/she used to?	0	1	2	3	4
	4	Seemed sad or depressed for several hours?	0	1	2	3	4
Anger	5	Seemed more irritated or easily annoyed than usual?	0	1	2	3	4
Irritability	6	Seemed angry or lost his/her temper?	0	1	2	3	4
Mania	7	Starting lots more projects than usual or doing more risky things than usual?	0	1	2	3	4
	7	Sleeping less than usual for him/her but still has lots of energy?	0	1	2	3	4

Anxiety	8	Said he/she felt nervous, anxious, or scared?	0	1	2	3	4
	8	Not been able to stop worrying?	0	1	2	3	4
	8	Said he/she couldn't do things he/she wanted to or should have done because they made him/her feel nervous?	0	1	2	3	4
Psychosis	9	Said that he/she heard voices—when there was no one there—speaking about him/her or telling him/her what to do or saying bad things to him/her?	0	1	2	3	4
	9	Said that he/she had a vision when he/she was completely awake—that is, saw something or someone that no one else could see?	0	1	2	3	4
Repetitive thoughts and behaviors	10	Said that he/she had thoughts that kept coming into his/her mind that he/she would do something bad or that something bad would happen to him/her or to someone else?	0	1	2	3	4
	10	Said he/she felt the need to check on certain things over and over again, like whether a door was locked or whether the stove was turned off?	0	1	2	3	4
	10	Seemed to worry a lot about things he/she touched being dirty or having germs or being poisoned?	0	1	2	3	4
	10	Said that he/she had to do things in a certain way, like counting or saying special things out loud, in order to keep something bad from happening?	0	1	2	3	4
Substance use	11	Had an alcoholic beverage (beer, wine, liquor, etc.)?	0	1	2	3	4
	11	Smoked a cigarette, a cigar, or pipe, or used snuff or chewing tobacco?	0	1	2	3	4

	11	Used drugs like marijuana, cocaine or crack, club drugs (like ecstasy), hallucinogens (like LSD), heroin, inhalants or solvents (like glue), or methamphetamine (like speed)?	0	1	2	3	4
	11	Used any medicine without a doctor's prescription (e.g., painkillers [like Vicodin], stimulants [like Ritalin or Adderall], sedatives or tranquilizers [like sleeping pills or Valium], or steroids)?	0	1	2	3	4
Suicidal ideation/ suicide attempts	12	In the past TWO (2) WEEKS, has he/she talked about wanting to kill himself/herself or about wanting to commit suicide?	0	1	2	3	4
	12	Has he/she EVER tried to kill himself/herself?	0	1	2	3	4

The measure contains 25 questions that measure 12 mental categories, (1) Somatic Symptoms, (2) Sleep Problems, (3) Inattention, (4) Depression, (5) Anger, (6) Irritability, (7) Mania, (8) Anxiety, (9) Psychosis, (10) Repetitive thoughts and behaviors, (11) Substance use, (12) Suicidal ideation/suicide attempts. Everything asks the parent or ASD children in respect to answer how much (or how frequently) his or her kid has been incommoding by the specific side effect amid the previous 2 weeks. The measure was set up to be clinically valuable and had great test-retest dependability in the DSM-5 field trials in pediatric clinical examples over the U.S.

As shown on table 2, Nineteen of the 25 questions are each evaluated on a 5-point scale (0=none or not at all; 1=slight or rare, less than a day or two; 2=mild or several days; 3=moderate or more than half the days; and 4=severe or nearly every day).

To track change in the child's symptom approach over time, the measure may be achieved at normal intervals as clinically demonstrate, relevant on the consistency of the child's symptoms and treatment status, and preferably by the same parent or ASD children relative. Persistently high scores on a specific category may express important and problematic symptoms for the child that might warrant further assessment, treatment, and follow-up. Clinical judgment should guide decision making [1].

The total score shouldn't calculate if more than 3 items left unanswered. The parent or ASD children relative should try to answered all the questions. We should calculate the **partial raw score** when 1 or 2 items are left unanswered, can be calculated by summing the scores of items which answered. Next, multiply the partial raw score by the total number of items on the measure (i.e. 8). At the end, total raw score will be calculated by dividing the value by the number of items which were answered [1].

Partial Raw Score = summing the scores of items which answered = **PR**

Total Number of Items = **TNI**

Number Of Items That Were Actually Answered = **NIA**

Total Raw Score =

$$\frac{\text{PR} * \text{TNI}}{\text{NIA}} \quad (1)$$

If the result is not round, round to the nearest number.

2.3 Recent Mobile Platforms

One of the related software in market is Smart Autism which is a cloud-based and computerized structure for autism evaluation and results. It is related framework proposed by Engineering in Medicine and Biology Society (EMBC) to appraisal and affirms autism in various age gathering (0 to 17 years) with 3 layers of evaluation process [19]. On the off chance that autism is suspected, in the virtual appraisal process, the kid watches a video, his response is recorded and transferred to the cloud for remote master evaluation. On the off chance that autism is as yet suspected, the child is referred to the closest Autism Resource Center (ARC) for real appraisal. Dissecting the outcome demonstrates the structure can affirm the autism naturally and decrease client's ARC visit and makes mindfulness.

The other application, by BMJ open, was about rationale and convention for utilizing a cell phone application to consider ASD, which is Longitudinal examinations on the development of ASD side effects [20]. They propose to think about the kid's ASD indications and their impact on the personal satisfaction, mental status and tension of the parents over a 6-month time span utilizing SMARTAUTISM, a smartphone application [20]. Information will be recorded longitudinally over different weeks under normal conditions. The factors affecting the quality of life and anxiety of parents with ASD and the children's functional symptoms will be investigated, and the usefulness of using a smartphone application designed for a parent of ASD children will be determined [20].

Chapter 3

SYSTEM ARCHITECTURE AND FUNCTIONALITY

The developed system has four main systems which are, (1) Mobile platform, (2) Web application platform, (3) Web services and (4) Database (Figure 1). The first 3 are always have communication with Database, the system database keeps the questionnaires, skill categories, educational mobile applications available in market and list of physical activities for ASD children. Main aim of system is automatically suggesting most suitable educational mobile applications or physical activities for children of 0-6 years old with ASD based on the result of questionnaires asked to parent by taking confirmation form ASD specialist.

There are four user roles in this system which represented by Autism Child, Parent, Teacher and Admin, each of them has different responsibility.

Admin has full permission to see all the data and ability to modify them. Teacher can see information and data related to students and parents, they can assign questions and activities to students. Parent responsible for answer the questions and perform the activities to students and let students play with assigned and appropriate mobile games. Autism Child (Student) should play with those game and start doing the assigned activities.

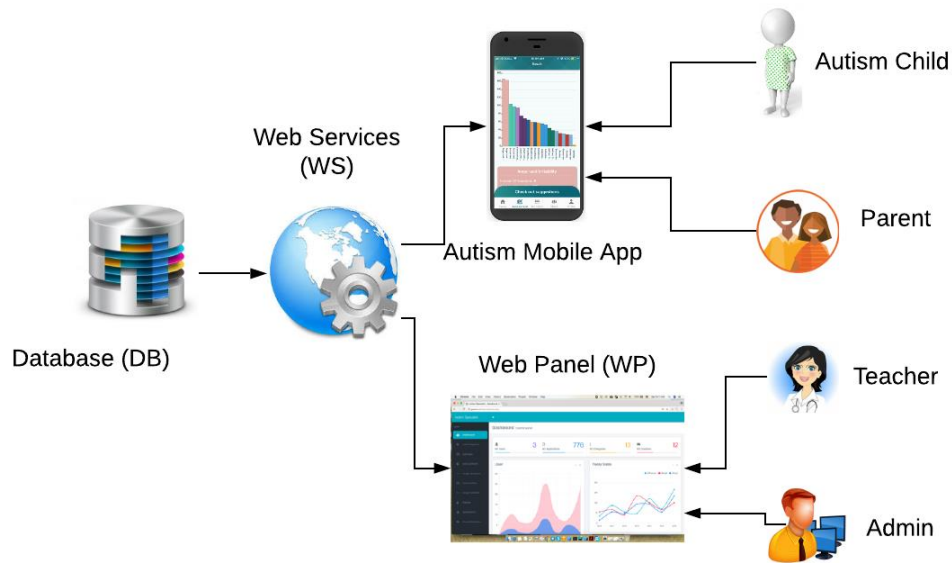


Figure 1. System Architecture of Proposed System.

3.1 System Data Design

Skill Categories

Each category in system indicates one skill for ASD children such as fine and motor, depression, speaking, anxiety, etc. In addition, each skill has a specific color in order to show in the charts more clearly.

Educational Mobile Applications for ASD

The system has Mobile Application Games that are available in Android/ IOS mobile markets especially developed for improving ASD skills. The applications in the system are searchable based on the predefined on the skill categories. Each application is kept in the system with the information of description, reviews, tutorial videos, rates, download link, supported devices.

Questions Lists for Assessment

The system has a question pool which is used for assessment of status of skills for children with ASD. Each question in the pool is connected at most three skill categories. The questions are used by teacher to assess each child with ASD. The question pool of system can be added and modified with new questions by ASD specialist. Teachers can create questionnaires for their students and assign the questionnaires to children automatically or manually in order to evaluate their recent skills. Each question has different weights base on the importance that will affected on the result score of skills. Teachers assign the weights to each question after selecting by consideration the range from 0 to 9.

Physical Activities

The system database involves physical activities lists. Literature studies indicates that the physical activities can help to improve the skills of ASD children. The physical activities can be represented in different formats such as text, video and images.

The community of ASD children over the Internet is not big yet and it's hard to find the answers of questions related to autism, for solving this problem, proposed system can be very useful. People can write their questions and problems in the proposed mobile application; other people can see them and give the answer or their experience; this section of application is share and open between all the persons which they download the application and even ASD teacher can answer to the questions from the Web panel.

The notification system is implemented. The system sends notifications automatically (a question is assigned by teacher to parents then the system automatically sends the

notification to parent's mobile device to inform them) for having more control it can be sent manually by teachers from the Web panel too.

Web Panel developed fully responsive and it can be used in all the browser and developed mobile application can be used in both Android and IOS devices.

3.2 System Functionalities

In our approach, we tried to make an automated system from the traditional approaches to save time and make decisions more accurate. There is some predefined question list that can be modified and added by teacher from Web panel, these question lists will ask from the parents inside the developed mobile application every two weeks [1], based on the weight and category of the question and the answers, system will calculate the most problematic category that should be improved. Around 1000 games related to autism is available in the system which the category of games is matched with the category of questions, finally the system will suggest the appropriate mobile application based on the results and it shows the charts and statistics about the rate of skills, relative can download the mobile applications and children should play with them in order of improvements. Also, teacher can assign activities to the children based on the calculation result by the system. There is another section in this system which is prepared for sharing the questions and answers related to autism problems between the autism relatives in the world and also can be answered by teacher. Automated and manual notification also implemented in this system which can notify the autism relatives about new processes.

There are 4 actors are involved in this system;

(1) Autism specialist (Teacher),

(2) Patient Relative (Parent),

(3) Children (Student) and,

(4) Admin.

Autism Specialist's Tasks

- Add & modify autism categories.
- Add & modify mobile application games.
- Add & modify questions & activities.
- Create questions & activities lists.
- Assign questions & activities to ASD children.
- Send notifications.
- Respond to shares.

Parent's Tasks

- Download the application from stores.
- Search the games base on category.
- Answer the assigned questions.
- Check the statistics.
- Check the system suggestions games & activities.
- Assign the games & activities to ASD children.
- Share with other parents.

Children's Tasks

- Play with assigned games and apply physical activities.

Admin's Tasks

- Full Permission to see and modify all the data and information in the system.

Web Panel and Mobile Application will be sync automatically because they are using the same data core.

After downloading the mobile application by Parent, the first-round questions will assign to him/her, each question has 5 types of answers:

- None not at all
- Slight rare less than a day or two
- Mild several days
- Moderate more than half the days
- Severe nearly every day

each of them has a point (start 1 to 5) that will be multiply with the weight of question and the result will be the rate of a question, by summing these rates system will find the total rate of each question list that connect to the specific category, finally system will understand the rate of each categories.

Mobile application will send the result of assessment to the WS then WS apply a query to database in order to find out the appropriate mobile application games that has same category as a highest category rate in the result. WS will return the suitable mobile application games and statistics result for displaying as a suggested games and charts, if is there any physical activity needed to be assigned, will be assign by ASD teacher or automatic base on the predefined rules.

Parents should download suitable mobile applications suggested by system after assessment and let the children play with them and if there are any suggested physical activities, try to explain the activity to the children.

All the steps applied up to this point will be performed every two weeks [1] and parents can see the improvement from the charts and statistic results of assessment applied.

On the controlling section, there is a Web panel that teacher and admin can check all the interaction which is happening with the system, they can manage all the categories, mobile application games, questions and physical activities.

Instructors can see all the children and all the statistics related to them, all the activities and questions with answers that have been asked from them and answer the problems that they share in the share section (Figure 2, Table 2).

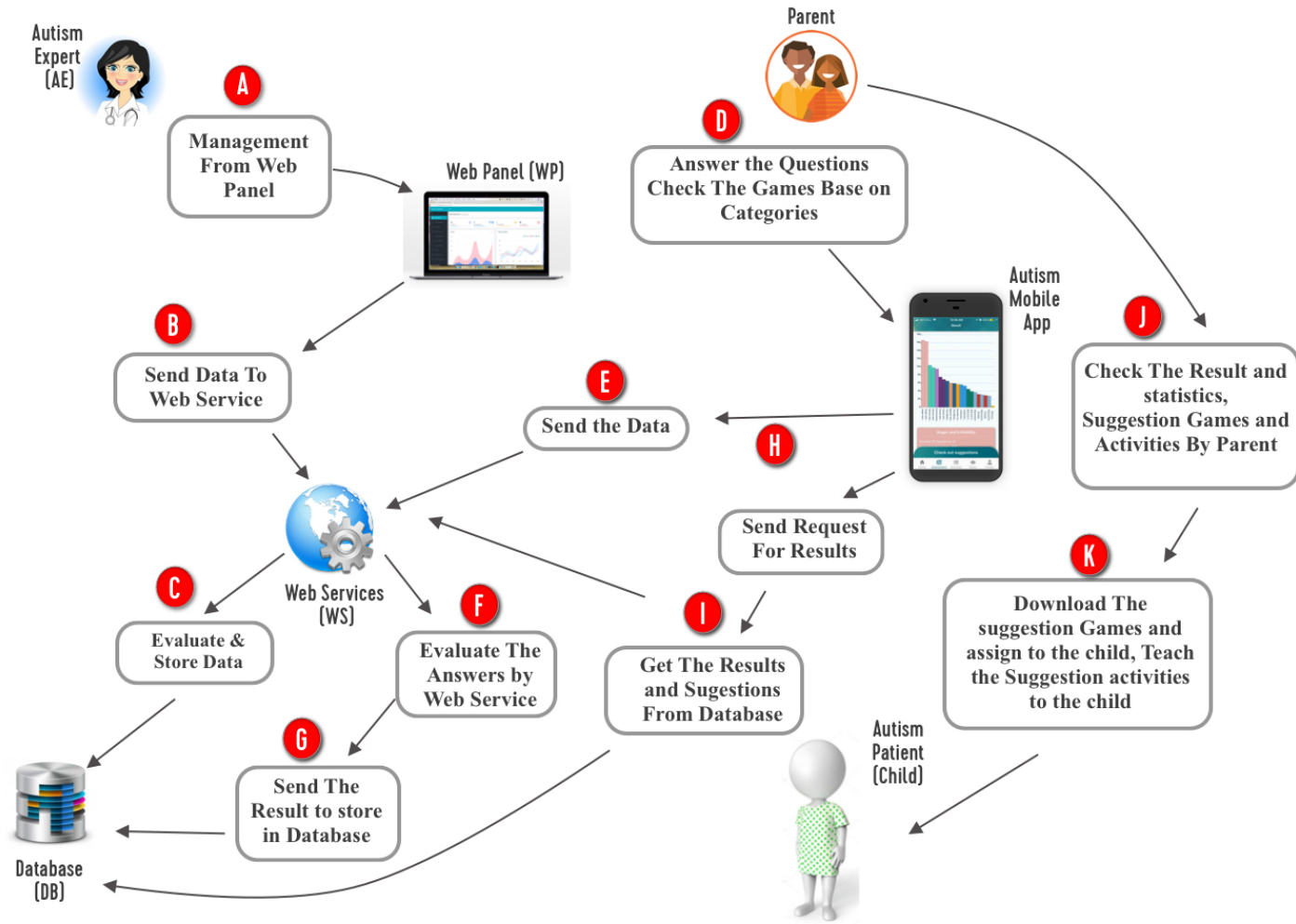


Figure 2. Processes and Actor Activities in the Proposed System

Table 2. Crucial Stages of Proposed System.

Stages	Explanation	Module
A	ASD Teacher Can Manage All the Categories, Games, Questions, Activities, Users from Web Panel.	AE, WP
B	Web Panel Sends the data to Web Services (HTML to PHP).	WP, WS
C	Web Service Evaluates the Data and Send Them to Database for Storing (PHP to MySQL).	WS, DB
D	The Question That Assign to ASD children By ASD Teacher Will Answer by Parent from The Mobile Application.	Parent, Mobile Application
E	Mobile Application Will Send the Data That Entered by Parent to Webservice	Mobile Application, WS
F	Webservice Evaluates the Request from The Mobile Application.	Mobile Application, WS
G	Webservice Send the Evaluated Data to The Database.	WS, DB
H	Mobile application Sends the Request for Getting the Result to Webservice.	Mobile Application, WS
I	Webservice Will Get the Result from Database, Evaluated and send it to Mobile Application.	WS, DB, Mobile Application
J	Parent Can Check the Statistics in Mobile Application And Can Check the Suggestion Games and Activities.	Parent, Mobile Application
K	Parent Should Download the Suggestion Games for The ASD children to Play and Assign the Suggested Activities to The ASD children.	Parent, Patient

3.2.1 Stage A: Manage by Autism Specialist

Autism specialist can add and modify all the (1) categories, (2) Games, (3) Questions, (4) Physical Activities from web panel. Also, there is a section that autism specialist can see all the details related to each ASD child, details like all the statistics, the questions and activities which assigned to the ASD children plus all the experiences that parents shared inside the mobile application.

3.2.2 Stage B: Relation between Web Panel and Web Services

All the data and information from the web panel will send to the web services, in technical view it gets the data with HTML forms and send them to web services that written with PHP.

3.2.3 Stage C: Relation Between Web Service and Database

Web service can evaluate the data check the accuracy of the data and if they need some process and changing, it will apply, then it sends them to the database as a query in order to store.

3.2.4 Stage D: Relation Between Parent and Mobile Application

Parents after downloading the mobile application, they will see some assigned questions by ASD teacher which they should answer them correctly, these answers are very important in this system and all the results will calculate base on these answers.

3.2.5 Stage E: Relation Between Mobile Application Web Services

After Answering the question by parents all the result will send to the web services from mobile application.

3.2.6 Stage F: Request Evaluates by Web Services

The are some functions and algorithms inside the web services which give the result calculation ability to them and they can evaluate the result. Those functions and algorithm discussed in detail in the “Assessment Functions” section.

3.2.7 Stage G: Storing Data in Database

The evaluated results by web services will send to the database and database store them in appropriate tables.

3.2.8 Stage H: How Mobile Application Gets Data

After storing the result, the system should display the result in the diagrams and charts bases inside the mobile application for parents, mobile application will send the request to web services in order to get the final results and show them.

3.2.9 Stage I: Result Evaluation

Web services will ask from database for the final result, after getting the result and sort them in the appropriate way it will send it to the mobile application.

3.2.10 Stage J: Parent Can Check the Statistical Result of Assessment

Mobile application will create the diagrams and charts base on the results getting from the web services and parents easily can open the application and check the statistics which shows the most problematic skills and game suggestions.

3.2.11 Stage K: Parent and Child

Parents can see the suggested games and activities from the mobile application which they should download the games from stores and let the ASD children play with it. If any activity assigned to the ASD children, Parents should teach the activity to the ASD children and ask the ASD children to do it in the describe way.

3.3 Used Tools

Mobile Application which developed by React-Native always send the request to the Database (MySQL) via Web Services (WS) which written with PHP, In the other hand WS get the data from Database and send them to the Mobile Application, WS will perform the interpreter role between Mobile Application and Data Base.

The same structure applied for the Web panel which developed by HTML, CSS, JavaScript, jQuery, Ajax, Web Panel can send requests and get responses from the database by WS.

Table 3. Used Tools.

System Parts	Used Technology	Description
Mobile Application (IOS, Android)	React-Native	Produce by Facebook, most voted in hybrid technologies.
Web Panel	HTML, CSS, JavaScript, jQuery, Ajax	With the combination of these technology can create a fully responsive web panel.
Web services	PHP	One of the comprehensive language for written webservices

Database	MySQL	Compatible with PHP
Notification system	Onesignal[21]	One the power full notification generators which is compatible with React-Native

3.4 Databases of System Developed

Database of this system created with MySQL because it's compatible with PHP, the language that used for developing web services. It has 14 table which all of them has relation with each other shown in Figure 3 (E.R Diagram). The tables are:

- **Categories:** each category in this system has unique ID, name, weight for scaling the level of importance and color for displaying in charts.
- **Games:** The games have lots of field for storing the detailed information related to each game and the field are: unique ID, android_id, itunes_id, category1 to 3, review 1 to 4, video1 to 5, published date, title, description, price, supported devices, rating and image and it connected to the category table with categories name.
- **Adding Question and Assigned Questions to Parents:** Each question is stored in question table and make a question table like question pool and each question need to have unique ID, tags which is shows the question belong to which list, insert date, type can be used for multiple purpose like being active, text which is the content of the question, image, weight for scaling the level of importance, category ID which is connect to categories table. In the Assigned Question table, the system records the question lists that will assigned to each ASD children.

- **Adding Activities and Assigned Activities:** This two tables are exactly same as Question and Assigned Question tables the only different is they store activities and assigned activity lists.
- **Adding Question and Activity Tags:** The lists name stored in these two table and connected to the Question, Assigned Question and Activities, Assigned Activities, they have only unique ID and name.
- **Chat:** This is the table that system stored all the experiences and question that the parents can share between each other and ASD teacher in this system, this table have unique ID, User Id that connect to the user table, category ID which is connected to the category table, content, likes the number of like that other people liked it, active, insert date.
- **Chat Responses:** The answer that parents and ASD teacher will give to the share question stored in this table with unique ID, share id which is connected to the share table, category ID, user ID, content, likes, active, insert Date.
- **Push Notifications:** All the push notification which will send automatically by system or manually by ASD teacher will be stored in this table and it has unique ID, title, content, user ID, send date.
- **ASD children:** Anybody who download the mobile application has one row in this table and the parent can modify the detailed information about their self with updating the field of this table from the mobile application and the fields are: unique ID, device ID the unique id of the device, notification ID the unique

id came from OneSignal[21] framework, email, password, register date, ASD
children age, type, image, active.

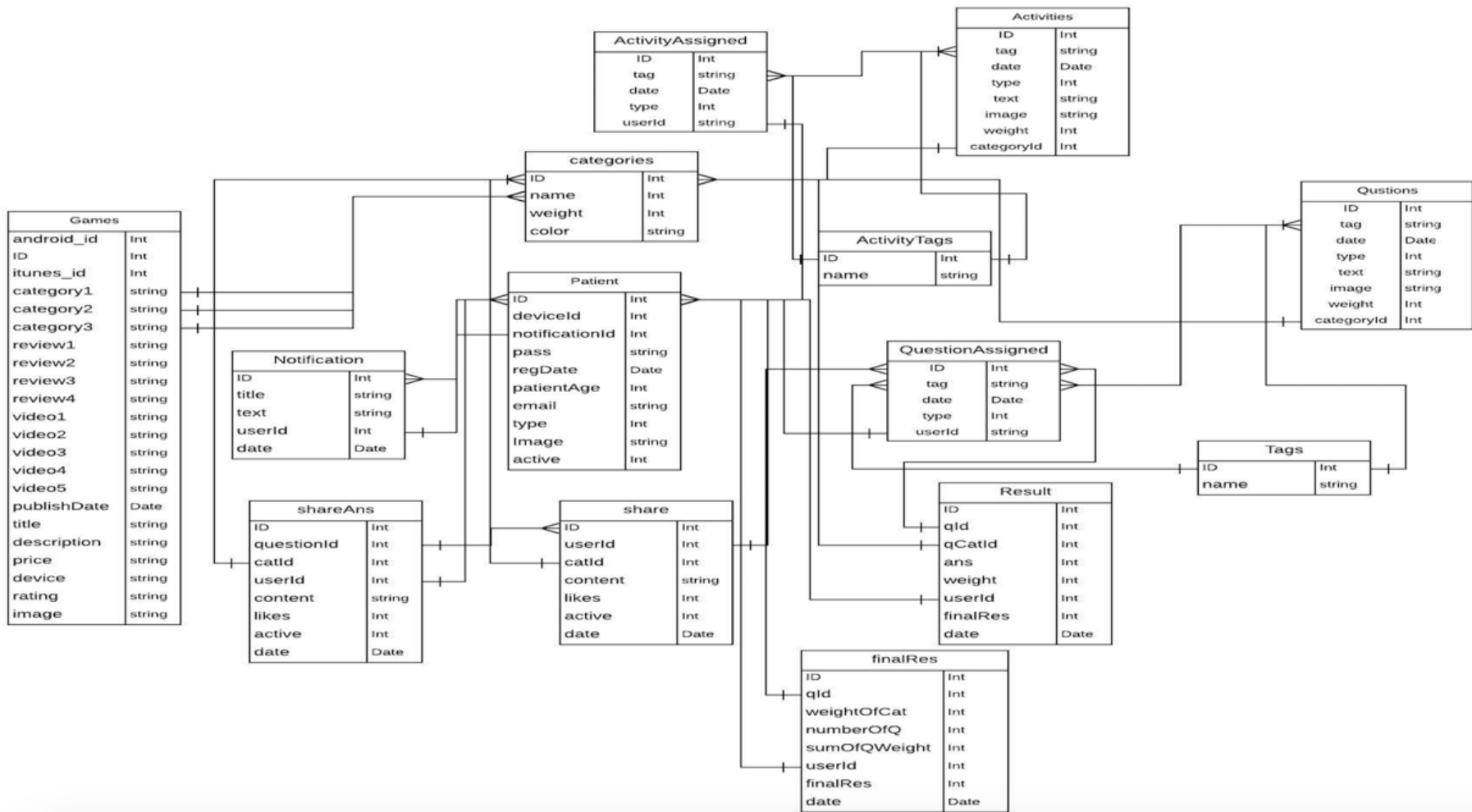


Figure 3. E-R Diagram

3.5 Web Services of System Developed

Web services are the interpreters between mobile application, web panel and database. They always responsible for getting the request from mobile application and web panel, send the request to the database and return the response to them. They written in PHP language because always PHP is working good with JavaScript and most of the section of mobile application and web panel developed by JavaScript. It developed in pure PHP without using any framework, simply it gets the request, send the request to database as a query and return the data in a JSON type.

This web services developed in a way which can be used in different applications and projects and share the data with them. They can upload to the server and if you put the server domain name plus these files name you can have access to them.

3.6 Web Panel of System Developed

This part of system is the part that handled all the management of the system. The ASD teacher can add and modify all the sections in the system, it possible to trace all the ASD children's activities and send them notification. It developed with HTML, CSS, JavaScript, JQuery and Ajax. HTML and CSS is used for developing the UI and designs, JavaScript, JQUERY and Ajax used for client-side scripting, they get the data from HTML inputs and forms and send them to the Webservices in order to process and store.

Web Panel will be config on appropriate host and domains, it has user management and login process, the ASD teachers can register and after activation they can login with their credentials and start to manage their panel. The menu of the web panel is described in Table 4.

Table 4. Web Panel Sections.

Sections	Description
Dashboard	ASD teacher can see the total statistics of the system. ex. Number of users, number of games ...
Add Categories	ASD teacher can check all the categories change their title or color and add new categories.
Add Games	In this section ASD teacher can add new Games available in the market or modify any Games.
Add Questions	This is the questions pool section, ASD teacher can add any question to any question list.
Assign Questions	After preparing the question lists, in this section ASD Teacher can assign the list to the ASD children.
Add Activities	This is the activity pool section, ASD teacher can add any activity to any activity list.
Assign Activities	After preparing the activity lists, in this section ASD teacher can assign the list to the ASD children.
ASD children	This the section that ASD teacher can track all the ASD children, it's possible to check their statistics, questions and their answer, activities ...
Notifications	With the help of this section, ASD teacher can easily send any type of notification to any ASD children and can see all the sent notifications.
Shared Questions	The content of share section that is available in mobile application can be seen in this section and ASD teacher and answer them from this section.

3.7 Mobile Application of System Developed

This mobile application can be download in the IOS and Android mobiles, It's completely free. It has 5 tabs, the first tab shows all the categories, by clicking to one of them you can discover all the games related to that category in the market with all the details and download links. The second tab is assessment tab, if there are questions assign to the ASD children, parent can check the questions in this tab and answer them, after answering all the question, parent can check the result statistics from this tab. There is a button in assessment tab that can show all the suggested games by the system related to parent answers result. The third tab is an activity tab, all the activities that assigned to ASD children can be seen from here with the photo and content text differentiated with category. The fourth tab created for share experiences and share question, it designs for sharing autism problem and experiences between parents, all the people that download the application can see these shares and can answer them even ASD teacher can check and answer them from web panel. The fifth tab is a profile

tab it shows the basic information related to person who is using the application plus language can change from this tab and all sent notification can be seen from this tab. Mobile application communicate directly with the webservice and send or get data from them. Can be downloaded from apple store or google play store. Figure 4 can explain the application navigation in the diagram basis.

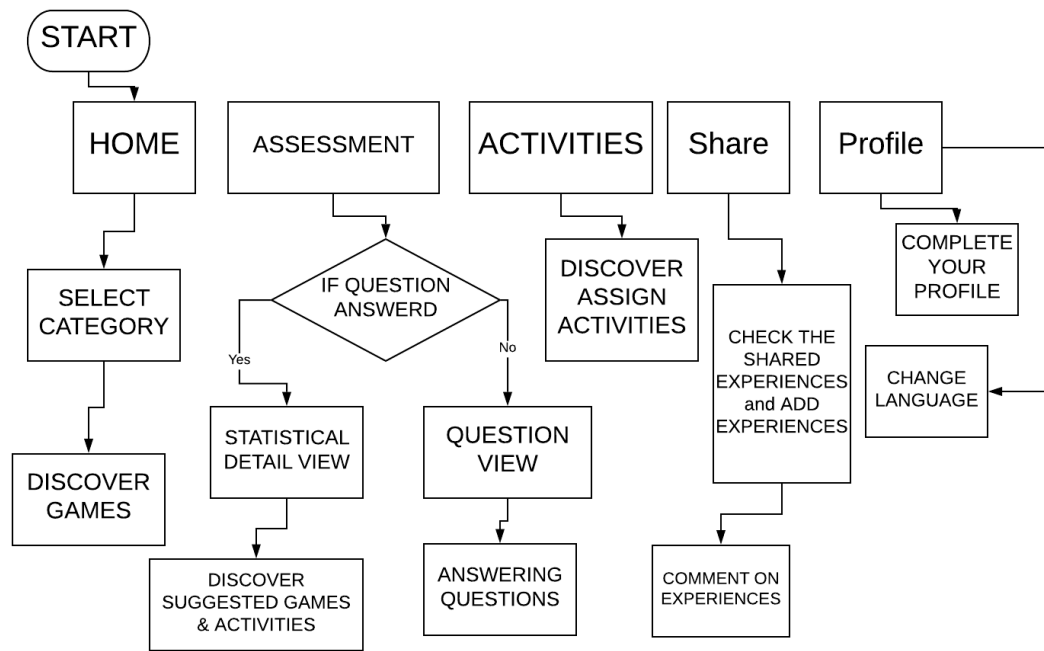


Figure 4. Mobile Application Navigation Sketch.

3.8 Assessment Functions Considered in Developed System

There are two main functions in this system, one of them calculates the score of each category from the answers that parent gives to the assigned questions. There are 5 types of answers that have 0 to 4 score, each question has a specific weight, first the system calculates the question rate with multiplying the question weight by answer score, then system will sum up all the questions rate related to specific category, the result will be the category rate Figure 5.

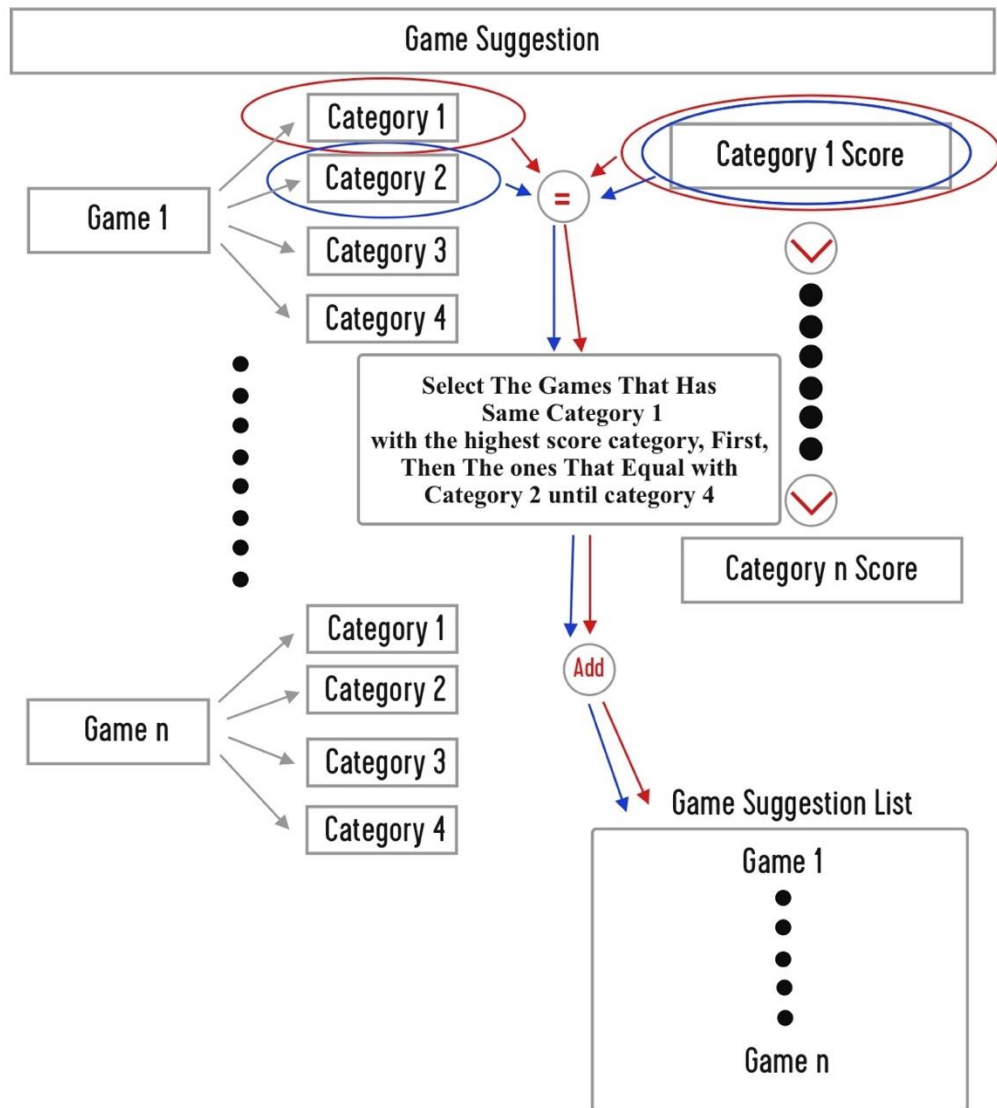


Figure 5. Game Suggestion.

The other function suggests the appropriate games from the result of first function, it sorts all the categories by the rate, the bigger one is the most problematic one then it find the games that has the first category same as the bigger one then checks the games that has the second category match with the bigger one and it goes until checks all the categories together and sorts the game base on the equal categories Figure 6.

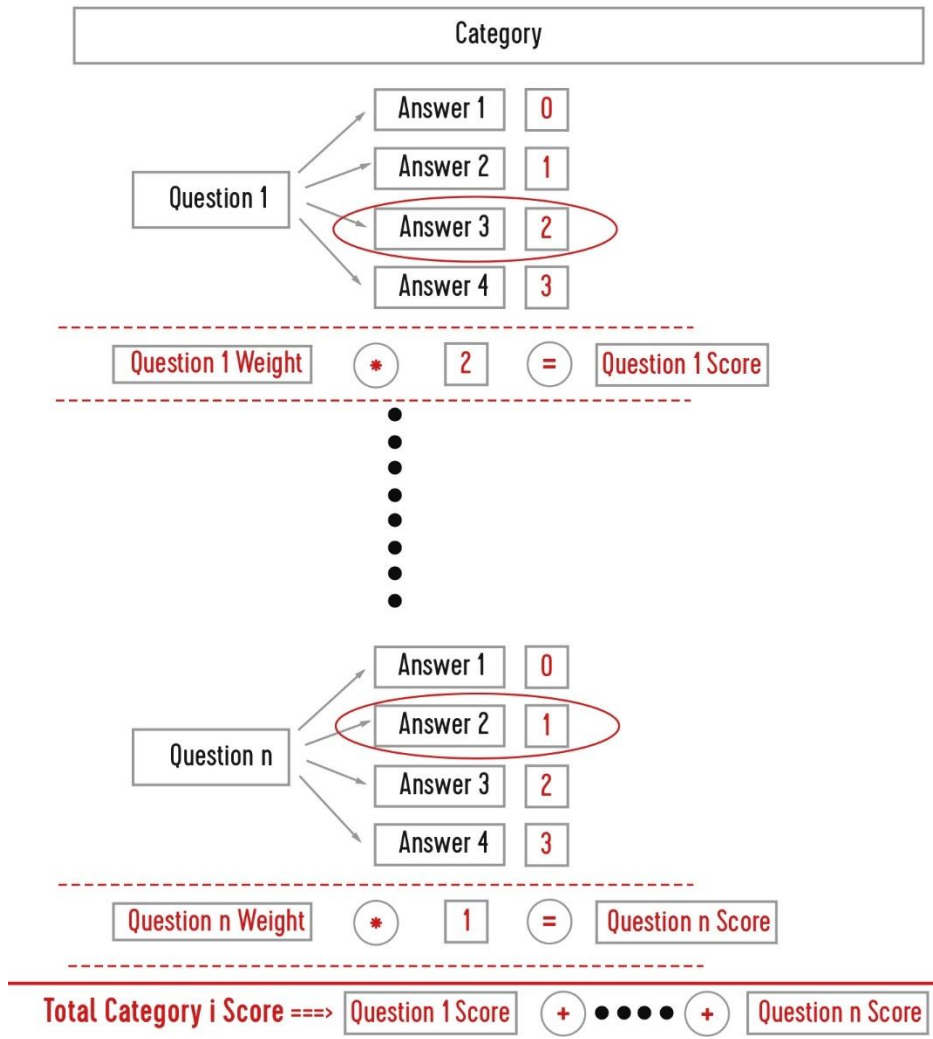


Figure 6. Category Score Calculation from Questions Score

Chapter 4

IMPLEMENTATION

The system divided to 3 separated sub system modules which are Web Panel Module, Mobile Application and Web Services Module. Web Services do not have interface as describe in Chapter 3, they can be access able with the domain on serve. This chapter is about implementation the web panel and mobile application furthermore showing the different kind of user interactions with system and their functionalities.

4.1 Web Panel Modules

There are two actors using the developed Web Panel Module which are Admin and Teachers. Web application recognize the role base on the user type and login credentials. The first page in web panel is login (Figure 7) which gets the email and password, send it to webservice and do the matching. If the credential is correct user base on the user type can see the home page and menu otherwise system show the login error.

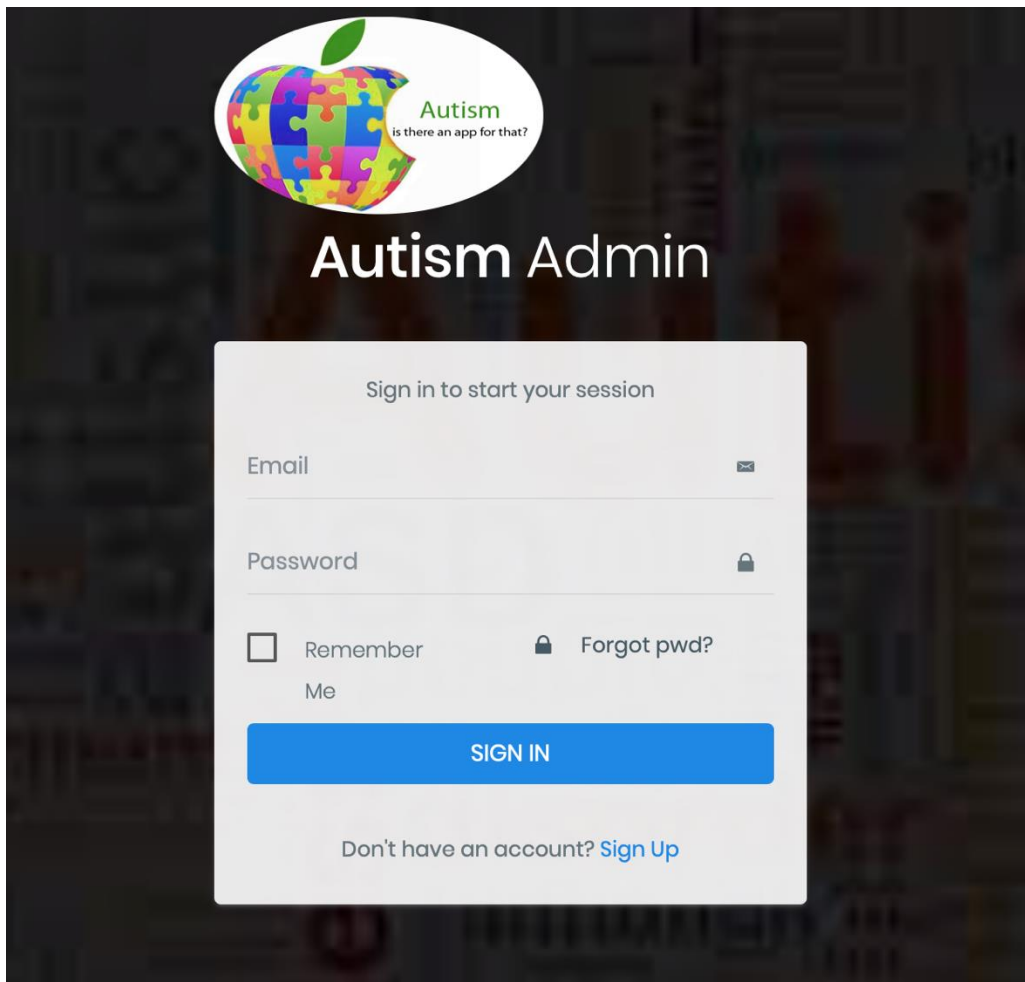


Figure 7. Login Page Web Panel

After user logged in to web panel home page (Figure 8) will be display which shows the menu and statistical represented by charts and numbers about the number of users, number of questions, number of games, numbers of activities and other appropriate reports for admin and teacher. The Menu includes:

- Dashboard
- Add Category
- Add Application
- Add Questions
- Assign Questions
- Add Activities
- Assign Activities
- Students
- Notifications
- Shared Questions

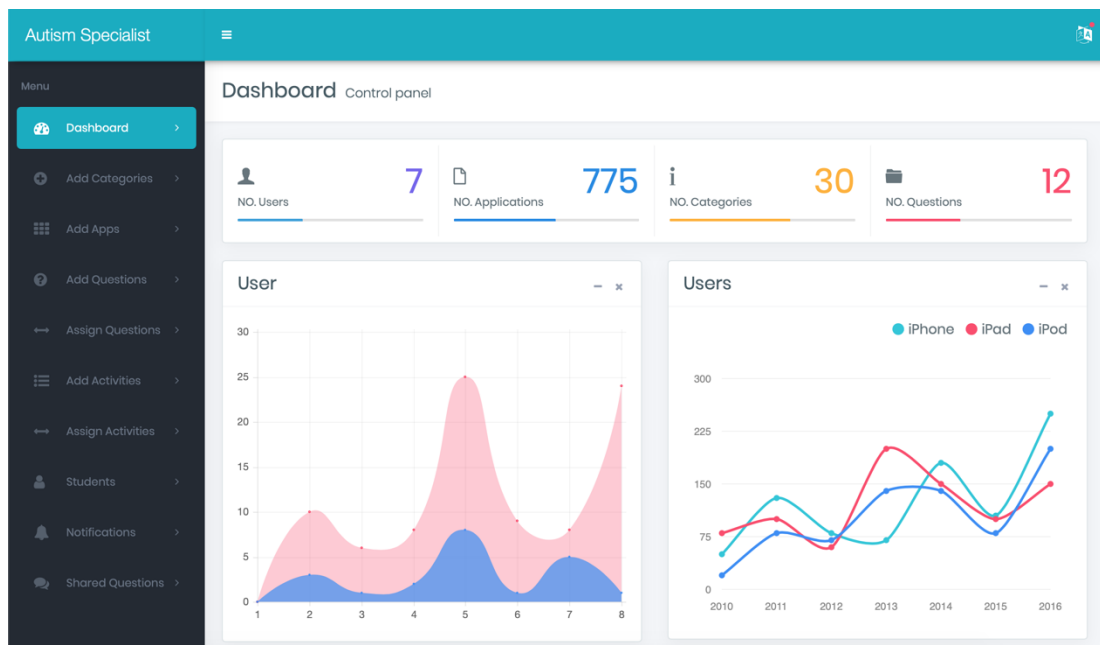
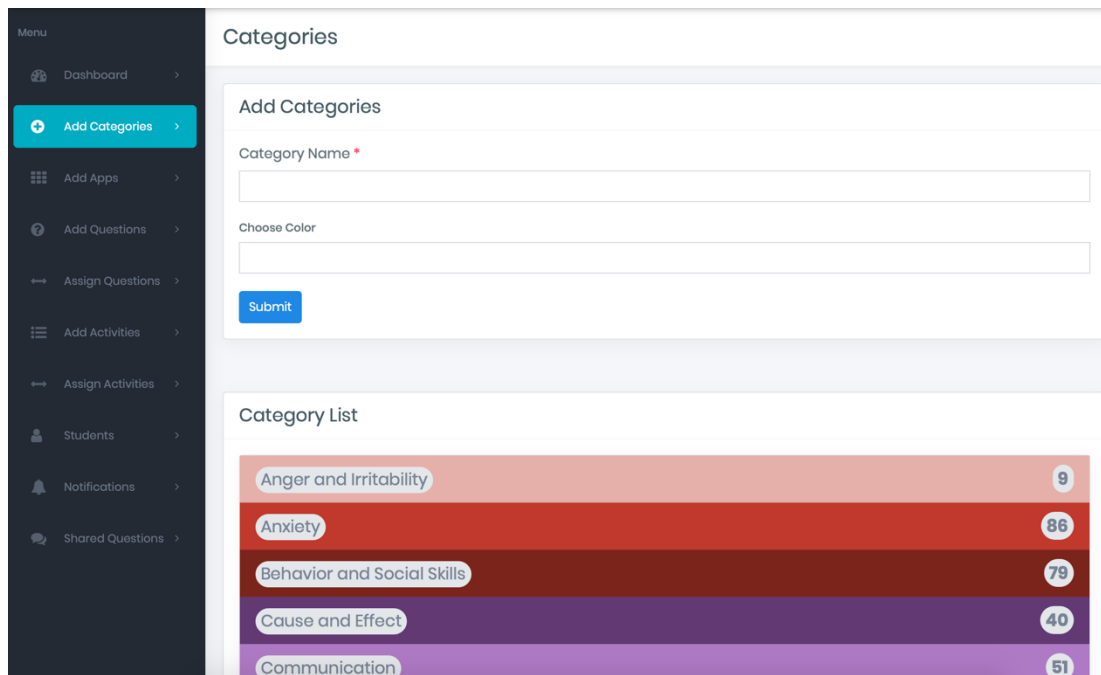


Figure 8. Home Page Web Panel

Add Category

In Add Category screen (Figure 9), Admin can add/edit/delete the categories, each category separated by different colors which represented appropriate category in entire system. The number of mobile games which exist in the system shown in front of each category.



Category Name	Number of Games
Anger and Irritability	9
Anxiety	86
Behavior and Social Skills	79
Cause and Effect	40
Communication	51

Figure 9. Add Category Web Panel

Add Applications

All the Mobile Application Games which exist in system can be find in Add Applications (Figure 10) screen, Admin can see all the Games and have the ability to modify them or add new one base on the categories.

Application Lists

Add Application

Find the application from the stores and fill the below information.

App ID *

Title*

Category*

Select a Category

Review 1

Review 2

Review 3

Review 4

Figure 10. Add Applications Web Panel

Editable with Datable

Just click on word which you want to change and enter

Show 10 entries

Search:

App ID	Title	Category	Device	Price	Image
284945681	Virtual Bubble Wrap Pop Challenge Best Popping Bubbles Games Free Appreciation Day 2016	Cause and Effect	iPad Only	0	
288732372	Tally Counter	School And Work	iPad & iPad	0	
290807369	Line Rider iRide	Depression	iPod & iPad	1.99	
291591378	Scoops Build Match Food Free	Depression	iPod & iPad	0	
293170168	Omnio Your personalized all in one clinical resource	Cause and Effect	iPad Only	0	
293630633	Word Magic	Speech and Language	iPad Only	0.99	

Figure 10. Add Applications Web Panel Games List

By clicking on each game there is an edit application pop up screen will display (Figure 11) which admin can edit the appropriate game from that screen.

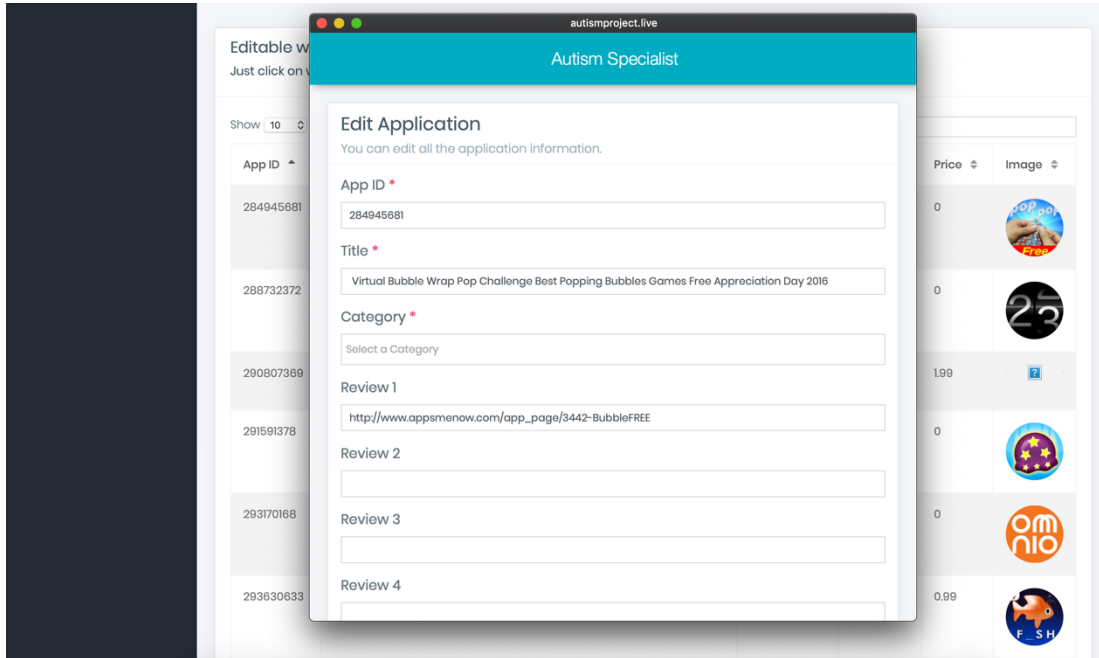
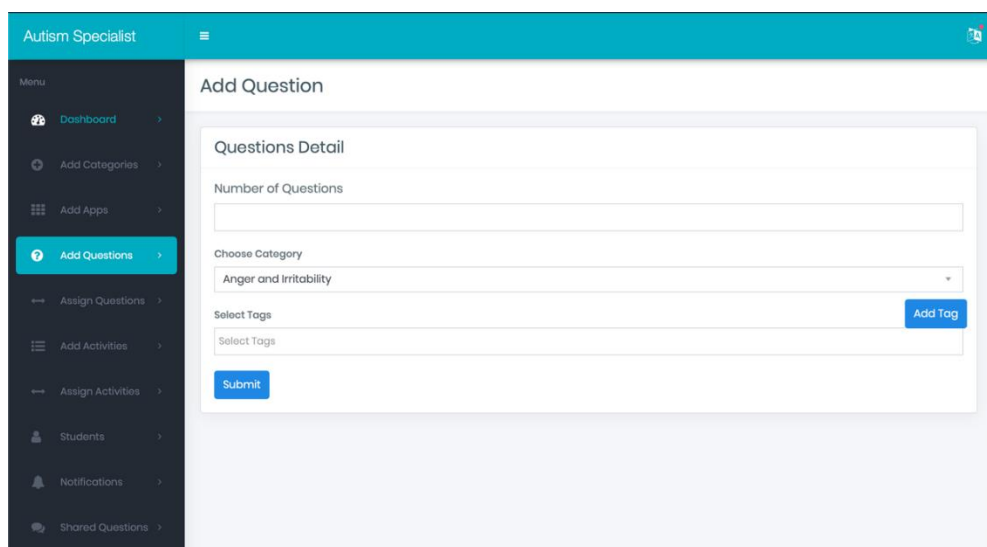


Figure 11. Add Applications Web Panel Edit Games

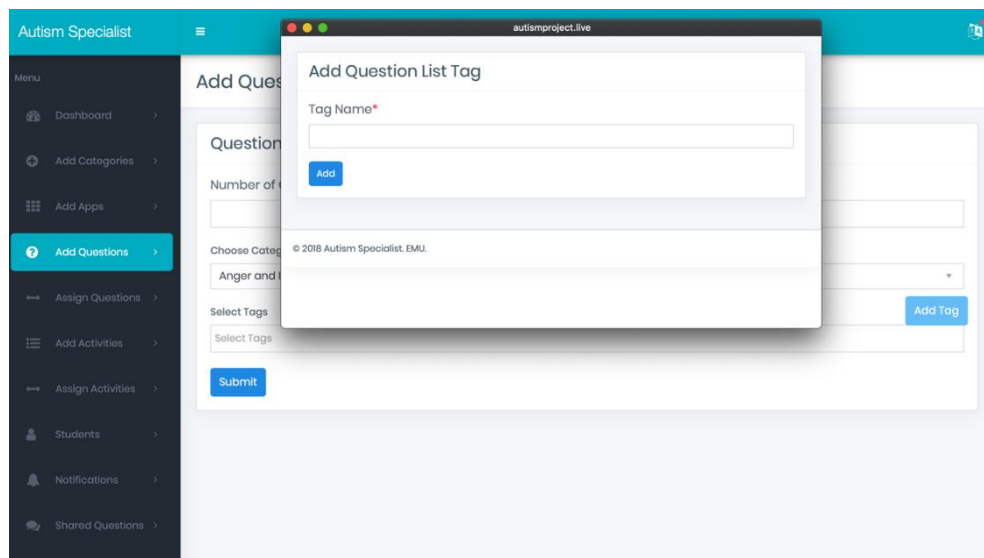
Add Questions

Questions are separated by categories and questions tag; each tag represents as title of question list and categories represent which question list is related to which category. This is one of the other roles of Admin which can Add Question in Add Question Screen (Figure 12). Tags can be added by clicking on Add Tag button which display Add Tag pop up Screen (Figure 13).



The screenshot shows the 'Add Question' web panel. On the left is a dark sidebar menu with options: Dashboard, Add Categories, Add Apps, Add Questions (highlighted), Assign Questions, Add Activities, Assign Activities, Students, Notifications, and Shared Questions. The main content area is titled 'Add Question' and contains a 'Questions Detail' form. The form has a 'Number of Questions' input field, a 'Choose Category' dropdown menu with 'Anger and Irritability' selected, and a 'Select Tags' section with an 'Add Tag' button. A 'Submit' button is at the bottom of the form.

Figure 12. Add Question Web Panel



The screenshot shows the 'Add Question Tag' web panel. A modal window titled 'Add Question List Tag' is open over the 'Add Question' form. The modal has a 'Tag Name*' input field and an 'Add' button. The background shows the same 'Add Question' form as in Figure 12, but it is partially obscured by the modal. The sidebar menu is also visible on the left.

Figure 13. Add Question Tag Web Panel

Assign Questions

After Creating the question pool and question lists in Assign Question Screen (Figure 14) Teacher can see the question list tags and assign the appropriate one to the appropriate student which both can choose from the drop-down box. Furthermore, teacher can see all the questions under each related tag.

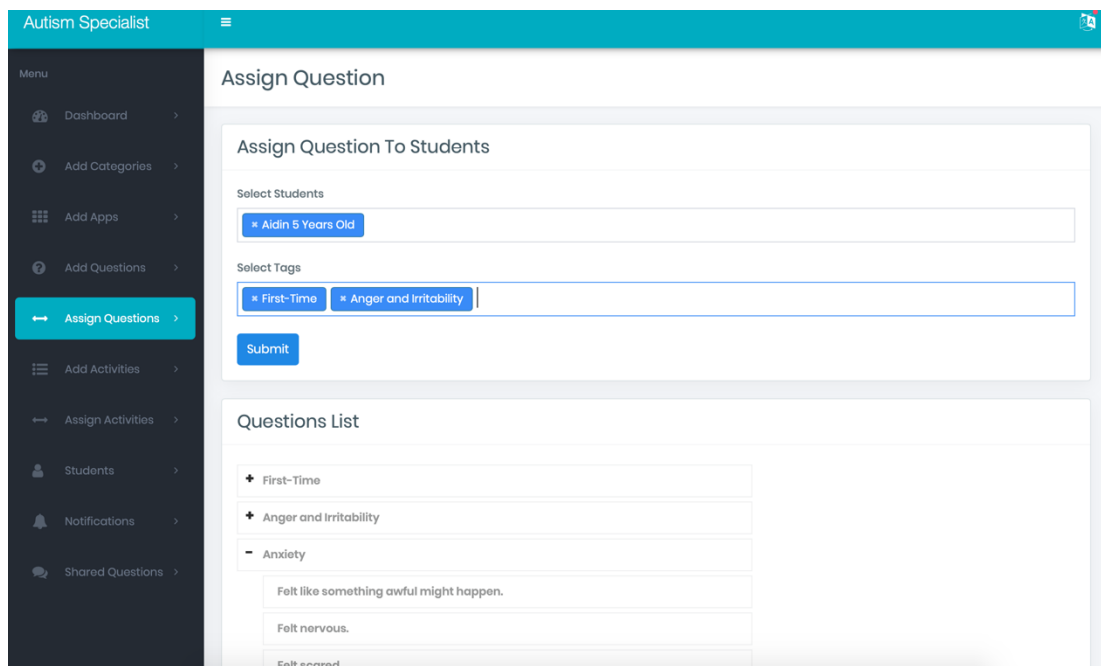


Figure 14. Assign Question Web Panel

Add Activities

Activities can be added in Add Activities screen (Figure 15) by Admin. Activities like Questions are depending on categories and activity tags. Activity Tags can be added by clicking Add Tag button in Add Activity Tag pop up screen (Figure 16).

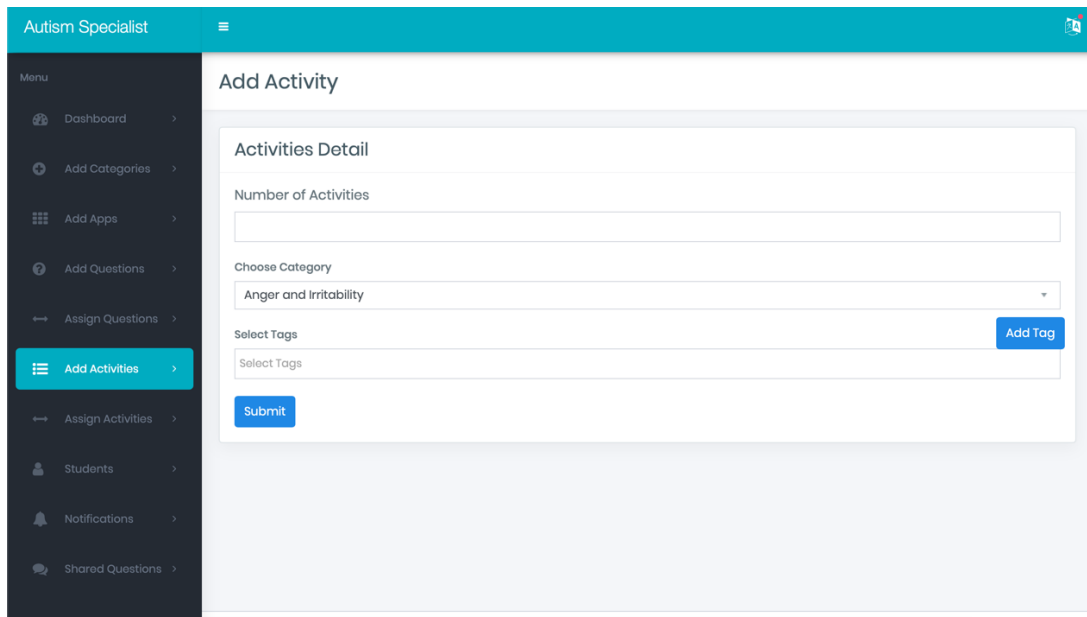


Figure 15. Add Activity Web Panel

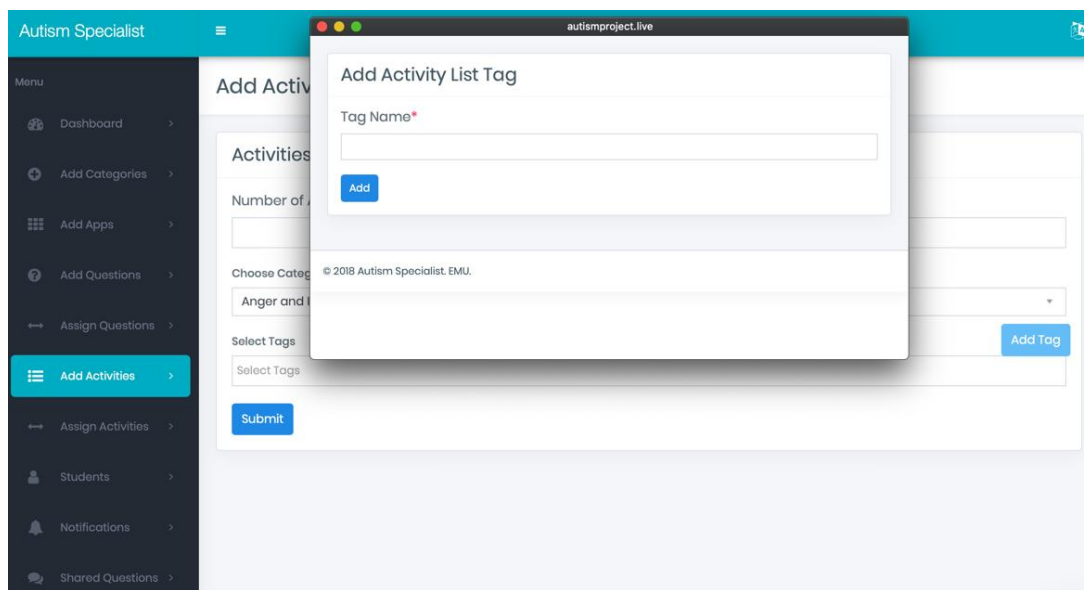


Figure 16. Add Activity Tag Web Panel

Assign Activities

After creating the activity pool and activity lists in Assign Activities screen (Figure 17), Teacher can see the activity list tags and assign the appropriate one to the appropriate student which both can choose from the drop-down box. Furthermore, teacher can see all the activities under each related tag.

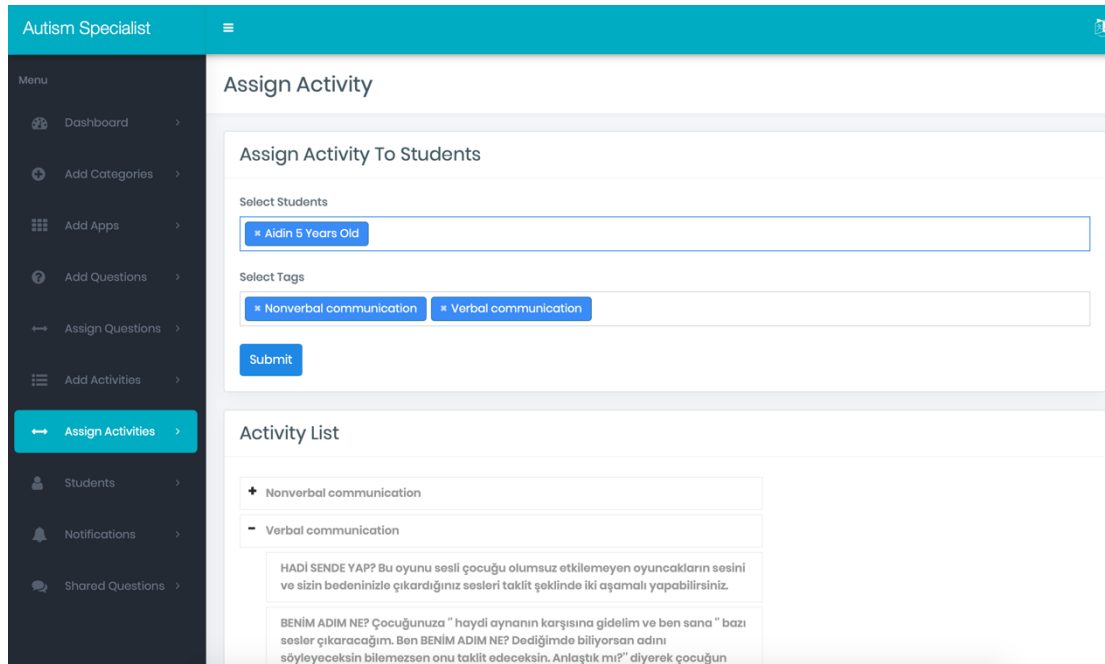


Figure 17. Assign Activities Web Panel

Students

Students Screen (Figure 18) shows the list of students which start using the mobile application. By clicking on each student Teacher can see the student history in 4 tabs.

The statistics tab (Figure 19) represent statistical result from answering the assigned question by student parents.

The Question Assigned Tab (Figure 20) shows all the questions with answers which assign to the student. Here Teacher can see the result and base on the question result Teacher can assign the appropriate activity base on that questions. Activities Assigned Tab (Figure 21) displays all the activities which assigned to student by Teacher. Share Question Tab (Figure 22) displays all the messages which student sent to Teacher and Teacher can respond to the message from this screen.

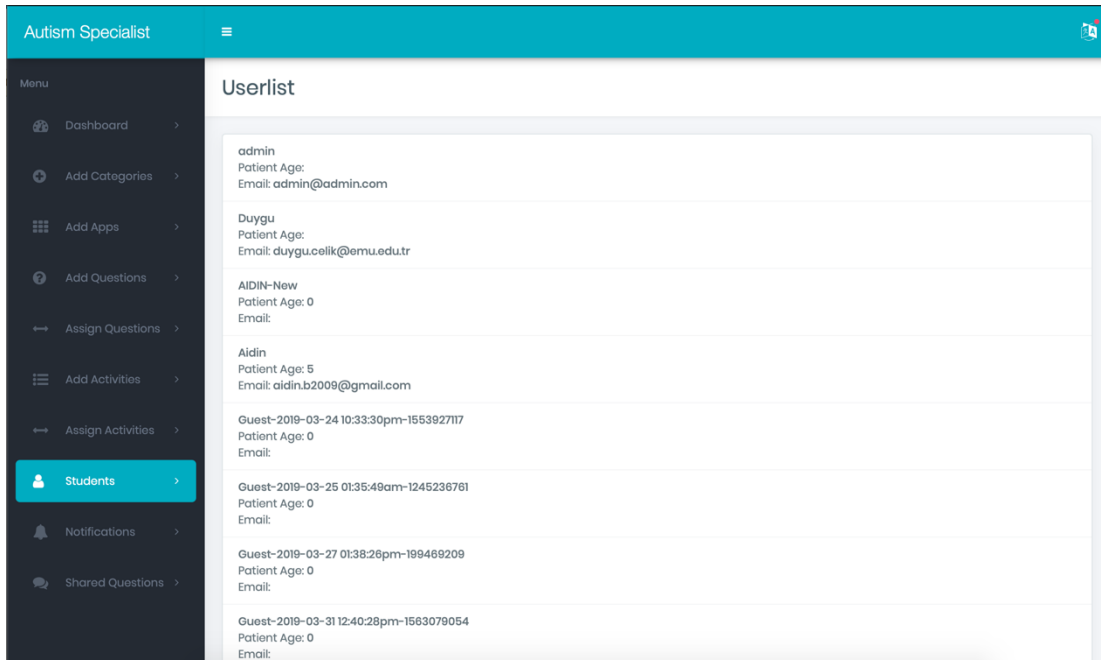


Figure 18. Student Screen

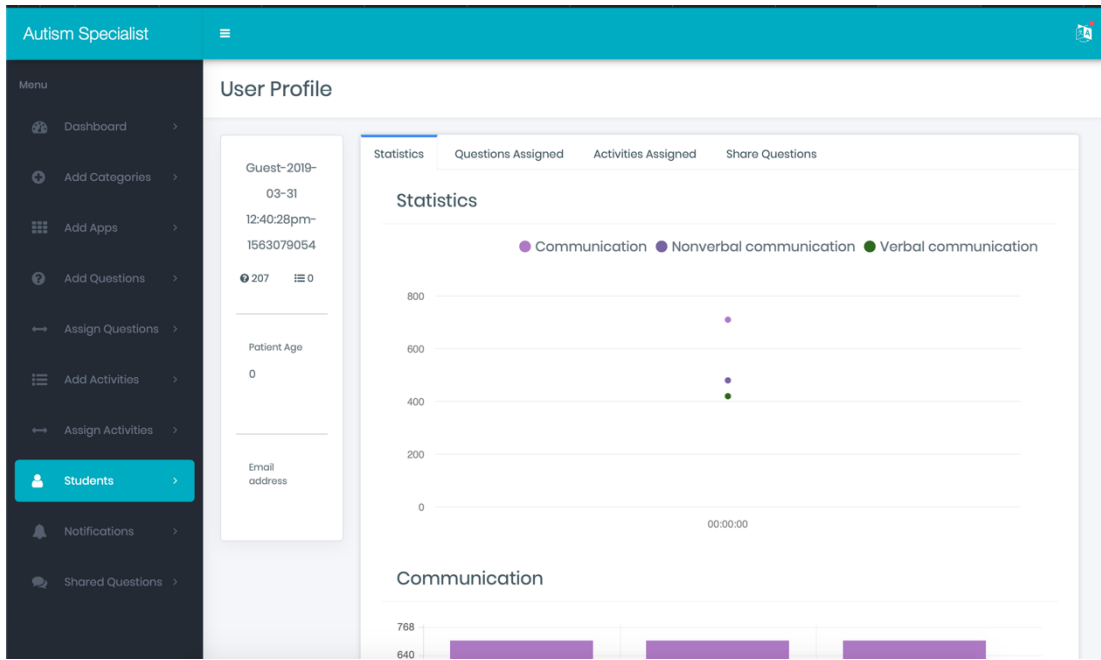


Figure 19. Statistics Screen

User Profile

Guest-2019-03-31
12:40:28pm-1563079054
207 0

Patient Age
0

Email address

Questions Assigned

Text	Category	Answer	Date	Weight	Activity
Allows him to be touched.	Nonverbal communication	1	2019-03-03	10	Assign Activity
The child allows the head to be stroked.	Nonverbal communication	2	2019-03-03	10	Assign Activity
The child allows his hand to be held.	Nonverbal communication	3	2019-03-03	10	
Holds someone else's hand when you asked.	Nonverbal communication	1	2019-03-03	10	Assign Activity
Plays the games played by holding hands.	Nonverbal communication	0	2019-03-03	10	Assign Activity

Figure 20. Question Assigned Screen

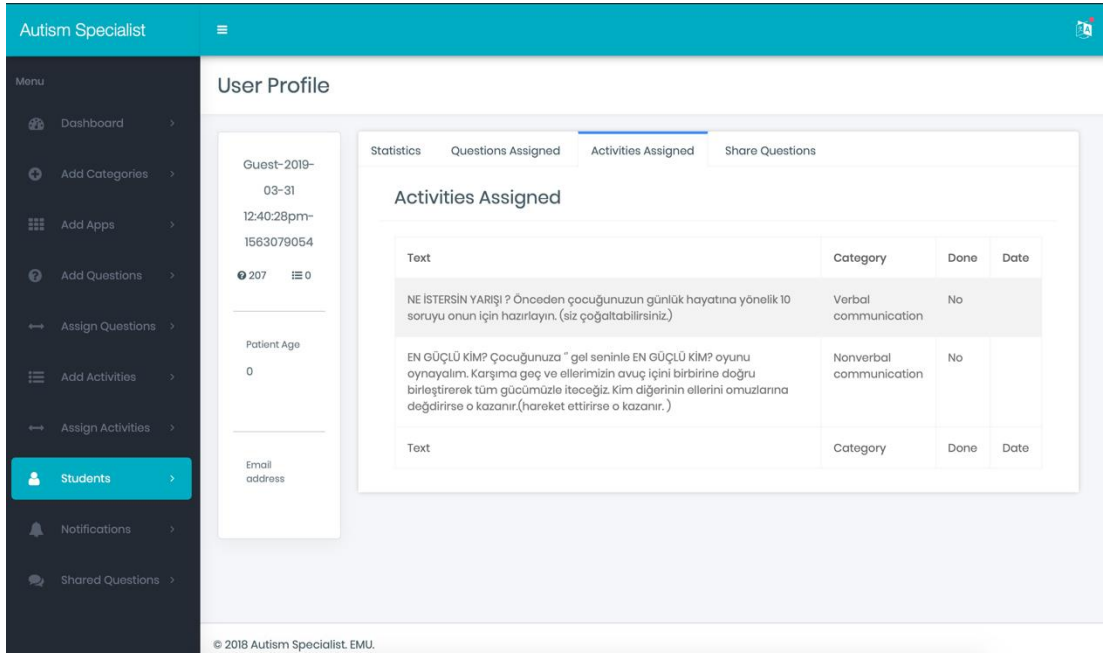


Figure 21. Activity Assigned Screen

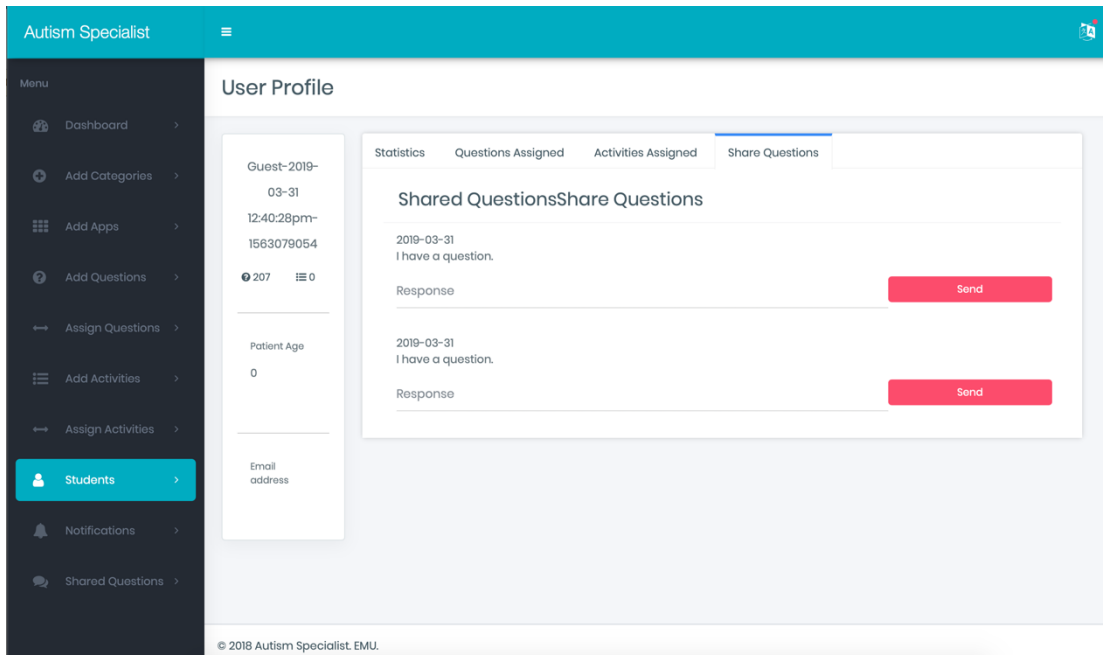


Figure 22. Share Questions Screen

Notification

The system has the ability to send push notification to the mobile phones which installs the Autism Mobile Application. Some Push are defined automatically in system such as when Teacher Assign Activities or Questions the system will send push notification. Furthermore, Teacher can send manually to the parent's phone from Notification screen (Figure 23), Teacher can choose the student and provide a title and message then by clicking on submit button, push notification will be send.

The screenshot displays the 'Autism Specialist' web interface. On the left is a dark sidebar menu with options like 'Dashboard', 'Add Categories', 'Add Apps', 'Add Questions', 'Assign Questions', 'Add Activities', 'Assign Activities', 'Students', 'Notifications', and 'Shared Questions'. The 'Notifications' option is highlighted. The main content area is titled 'Notifications' and contains two sections. The top section, 'Send Notification', has a 'Select User' dropdown set to 'admin', a 'Title' input field, and a 'Description' text area containing 'Textarea text'. A blue 'Submit' button is positioned below the description field. The bottom section, 'Notification Assigned', features a search bar, a 'Show 10 entries' indicator, and a table with columns for 'Description', 'User', and 'Date'.

Figure 23. Notification Screen Web Panel

Shared Question

The Autism Community is not big enough and finding the document related to Autism is hard, that's why we added the Shared Question Module (Figure 24) which all the parent can share their experiences or ask their questions and all the Teachers can see them and respond to those questions all the conversations will store in system and opens for everyone to read it.

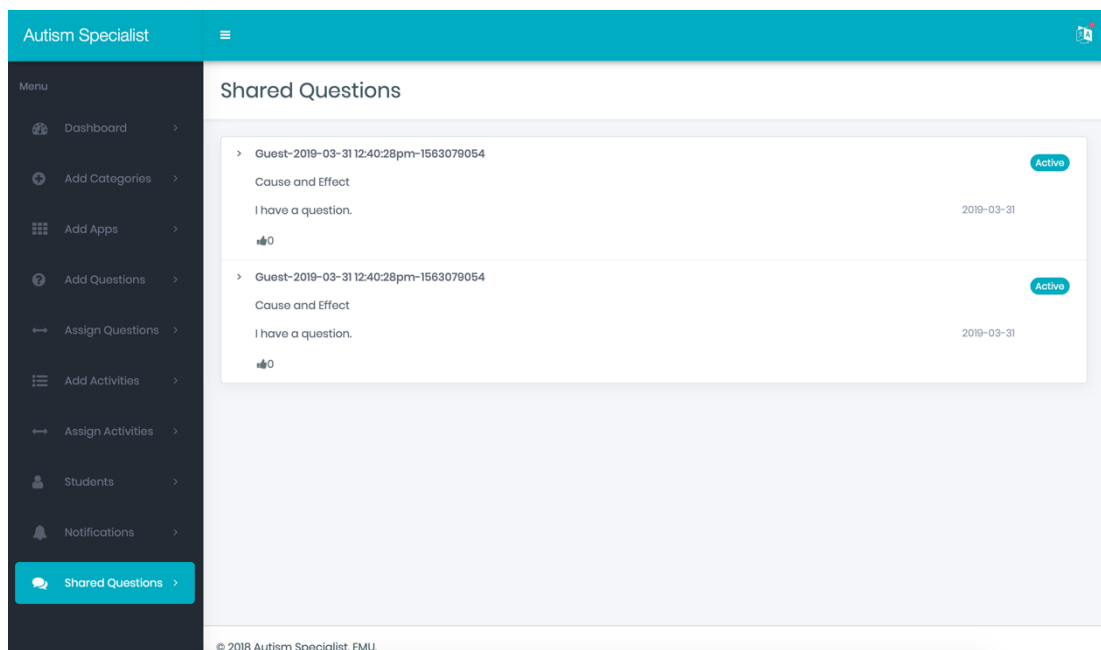


Figure 24. Shared Question Screen

4.2 Mobile Application Modules

Autism Mobile Application developed for using in both IOS and Android devices, In development phase for deployment the application, there are several methods for deployment, which Autism application using the AppCenter (Figure 25) for deployment, it needs an email to registration in AppCenter then AppCenter will send invitation to that email then the email owner can download the application from AppCenter generated link (Figure 26).

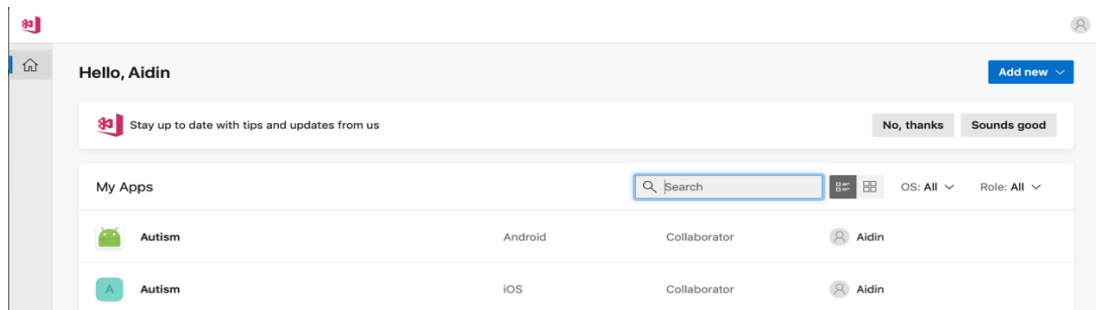


Figure 25. AppCenter Dashboard Autism Application

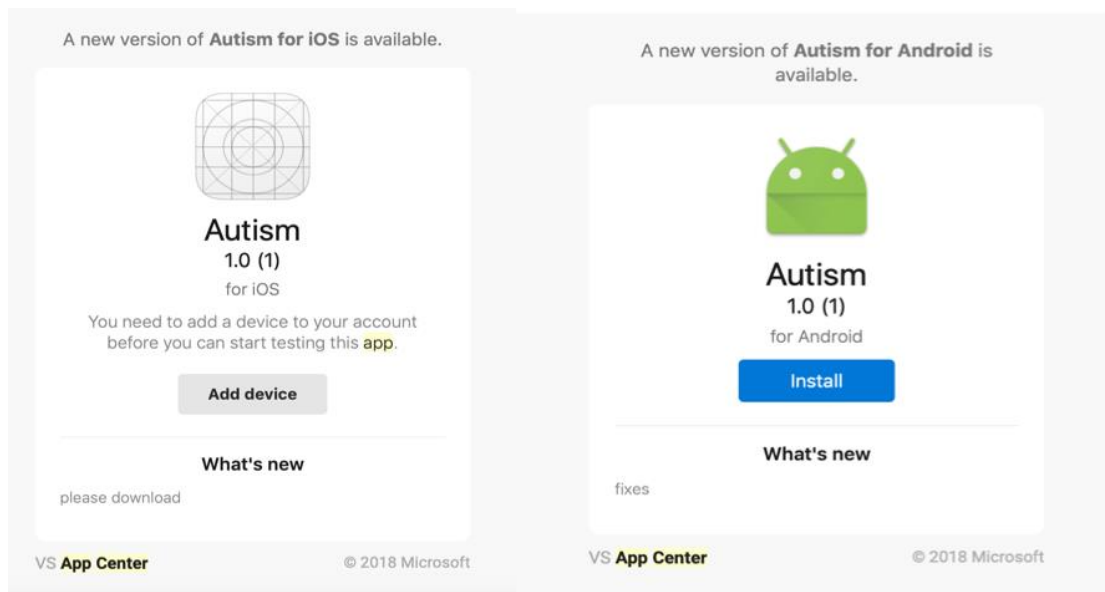


Figure 26. AppCenter Download link

Autism Mobile Application have 5 main modules (Figure 27) which the define as:

- Home
- Assessment
- Activities
- Share
- Profile

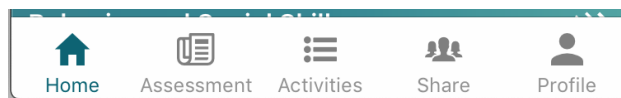


Figure 27. Mobile Application Tabs

This section will demonstrate all these modules. After Installation the Autism Application Language selection screen (Figure 28) will display, which let user to choose the desired language.

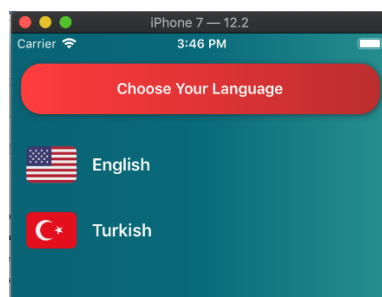


Figure 28. Choose Language Screen Mobile Application

Home Page

All the mobile games which stored in the system database can be reach from Home page (Figure 29) base on their categories. Parents can choose the appropriate category then in next screen (Figure 30) they will see list of mobile games related to chosen category. By clicking on each game, they can see all the detail information (Figure 31) about the chosen game, information about descriptions, reviews and download button for which redirect them to iOS/Android Stores in order to download the game.

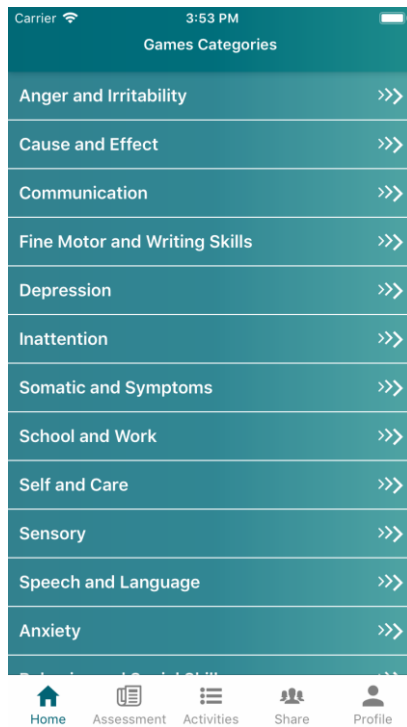


Figure 29. Home Page Mobile Application

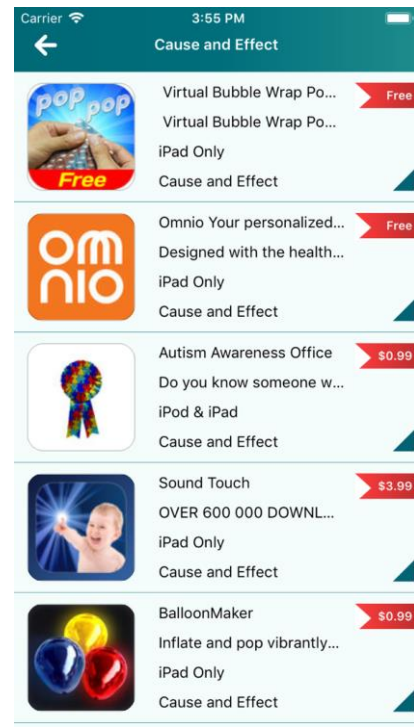


Figure 30. Game List Mobile Application

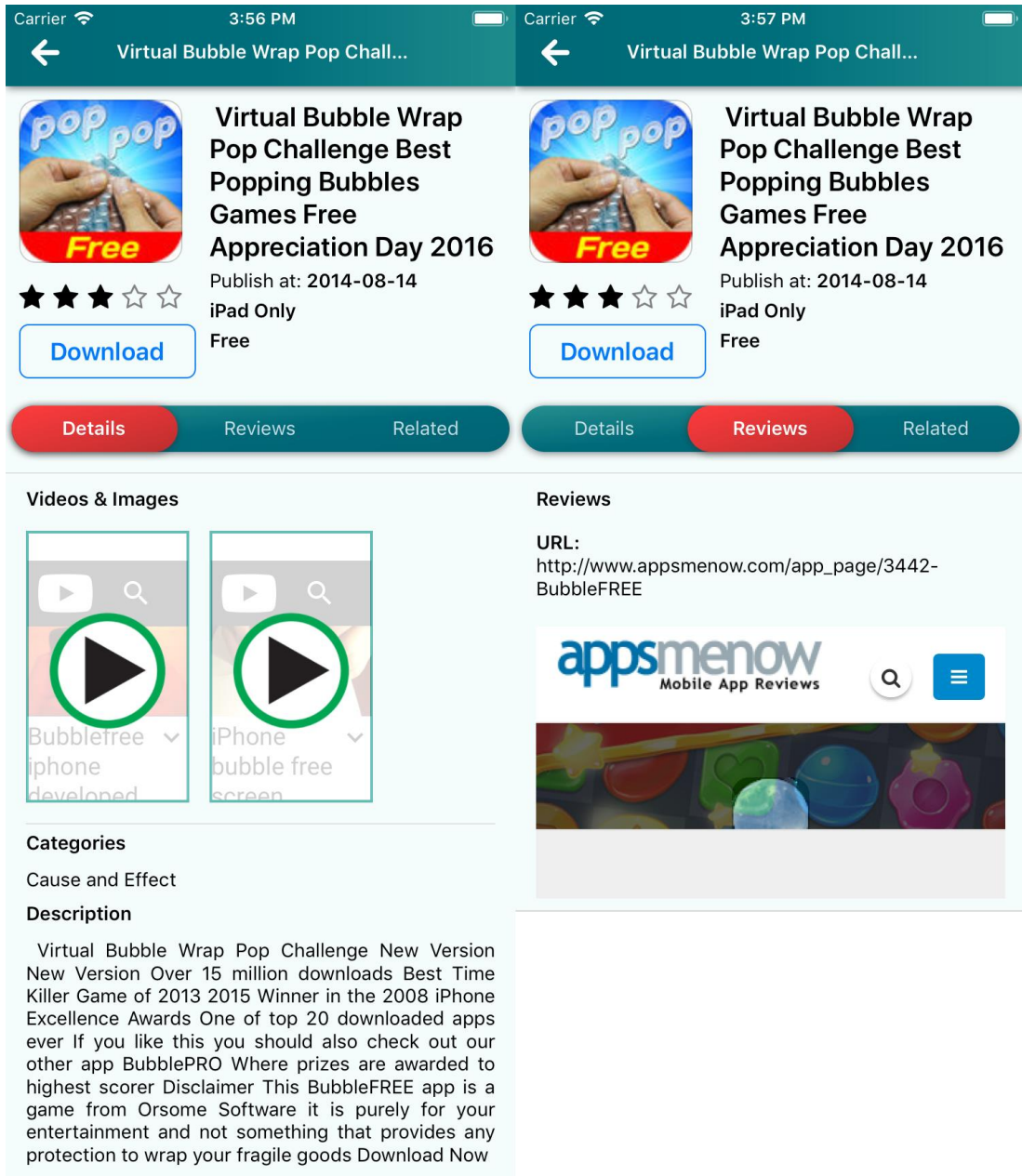


Figure 31. Games Detail Information Mobile Application

Assessment

There are two types of assessment in this system:

- DSM5 Assessment Approach (Appendix A)
- Assessment of the Ministry of National Education (Turkish: MEB-Milli Eğitim Bakanlığı) (Appendix B)

System has two buttons in the Assessment screen (Figure 32) which represent above types. Parent can choose either of them after clicking on them parent can see the questions (Figure 33) and start to answer them one by one, after answering all the questions parents can see the result (Figure 34) in charts categorized base on their categories.



Figure 32. Assessment Screenshot

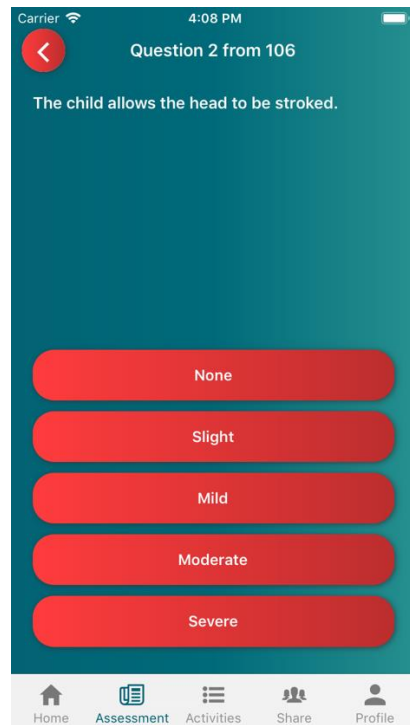


Figure 33. Question Screenshot



Figure 34. Result Screen Mobile Application

Parent can click on each category in the result screen and see the detail information related to that category displays in another screen (Figure 35) which includes three tabs:

- Activities (Figure 36)
- Game (Figure 37)
- Questions (Figure 38)

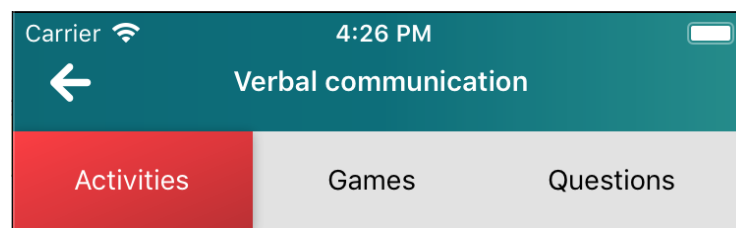


Figure 35 Tabs in Result base on categories

In Each Tab they can see appropriate activity, game and question which related to chosen category with all belong detail information.

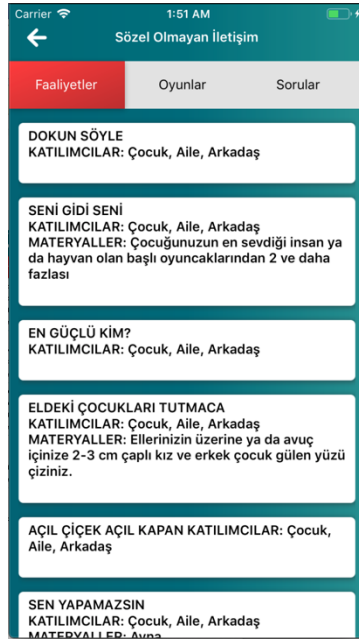


Figure 36. Activities in Result

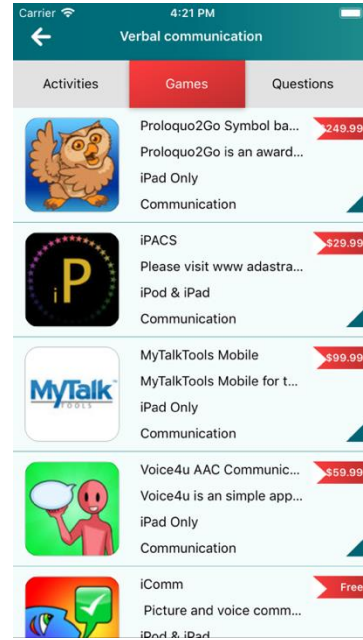


Figure 37. Games in Result

Carrier 4:21 PM

Verbal communication

Activities Games Questions

1	When you're asked, you can hear the sounds that he/she know and enjoy.	2
2	Simulates the new sound given.	1
3	Tells the source of the new sounds given.	0
4	Makes the sounds that is given with its source of the sound (nature, vehicle, animal, etc.).	2
5	He listens to music.	3
6	He says that the voice he listens to is the sound of music	2
7	Simulates the sound of music.	1
8	Distinguishes the "sound of music" from two different sounds.	0
9	Distinguishes the "sound of music" from the sounds he hears around him.	2

Number Of Questions 28
Questions More Than 2 Point 5

Figure 38. Evaluation Results of Assigned Questions

Activities

In Activities screen (Figure 39), Parent can see all the activities which assigned to student by teacher, they are displaying with different colors which shows the related category. By clicking on each activity, the detail activity screen (Figure 40) will show which explain the activity completely.



Figure 39. Activities Screen

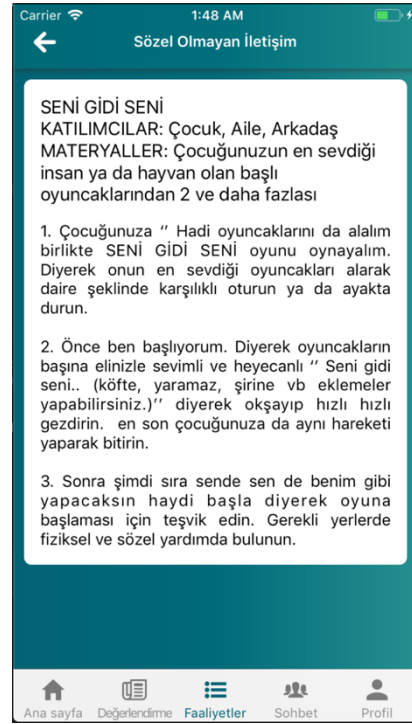


Figure 40. Activity detail screen

Share

As describe in chapter 3 there is the messaging module in system which parents can ask or share their experience with other parent and teachers, also teachers can respond them from web panel. Parent can write their question or share their experience from Share screen (Figure 41), there is a plus button at the top of the share screen which opens another screen (Figure 42), parent can choose the category and write their message on that screen then submit it.

Whoever wants to replay or write review by clicking the chosen question they can write their replay in chat screen (Figure 43).

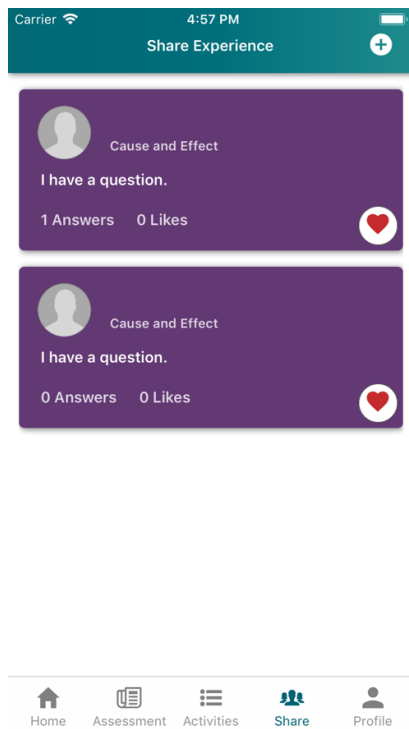


Figure 41. Share Screen

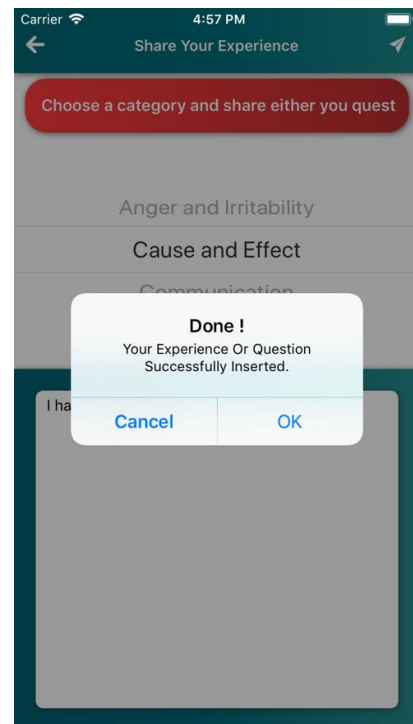


Figure 42. Add Message

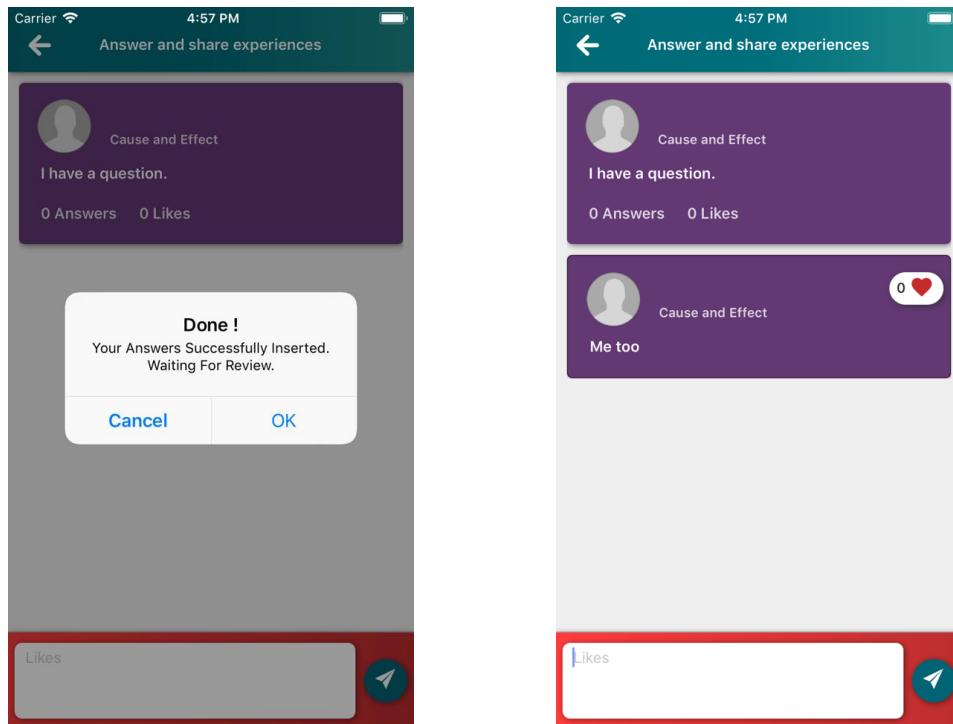


Figure 43. Answering the Shares

Profile

The Profile Tab (Figure 44) is the last tab in mobile application which shows the sent notifications plus the users can create the profile (Figure 45) furthermore, they can change the application language in Setting screen (Figure 46).

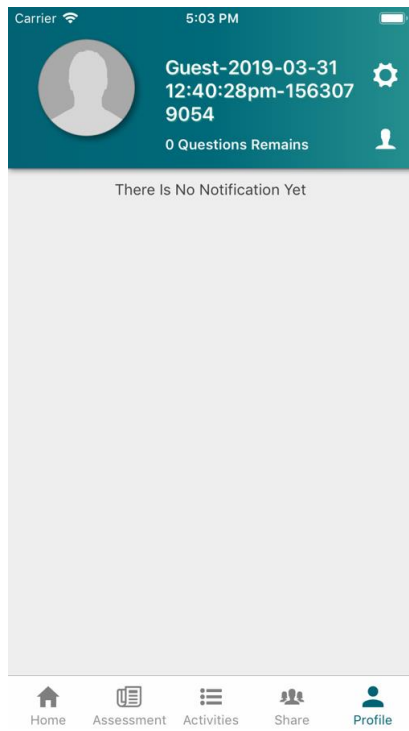


Figure 44. Profile Tab

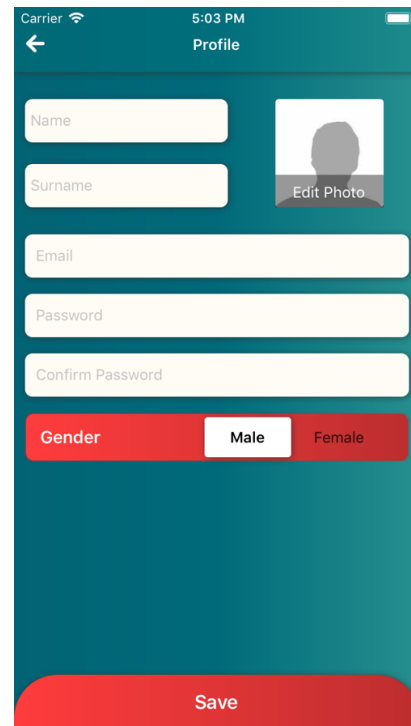


Figure 45. Create Profile



Figure 46 Setting Screen

Chapter 5

EXPERIMENTAL RESULTS

5.1 Experimental Setup

In our experiment for testing purpose of our system we considered a scenario, Autism Teacher which will work with web panel of the system and a child with ASD and their parents which will use the mobile application of system.



Figure 47. Assessment Section in Mobile application

Concentrated Scenario for Case Study

Mike is a five-year-old boy. Mike is not being able to pronounce most of the words and is hard for him to say a word in correct way. Mike try to pronounce “food”, which he says as “ood”. During the day, Mike cries and falls to the floor to gain access to food, obtain a favorite toy, or when he wants to be picked up. His parents try to help Mike to make him say with word whatever he want to have, but do not know how to help her and they don’t know which skills Mike needs to improve in order to solve all his problem. His parent starts to search about ASD and they found the autism application, they download the application in their mobile phone, they start to answer the questions in assessment section of application (Figure 47), after answering all the questions (Figure 48), the platform shows (Figure 49) that Mike needs to improve the Verbal Communication, Nonverbal Communication and Communication, with the Nonverbal Communication with the highest ranks among them.

Menü

- 📊 Gösterge paneli >
- 📁 Kategori ekle >
- 📱 Uygulama ekle >
- 📝 Soru ekle >
- 🔗 Sorular Atama >
- 📋 Etkinlik Ekle >
- 🔗 Etkinlik Ata >
- 👤 **Öğrenciler** >
- 🔔 Bildirimler >
- 🗨️ Paylaşılan Sorular >

Kullanıcı profili

MIKE

👤 204 📄 0

Hasta yaşı

0

e-mail adresleri

istatistik Atanan Sorular Atanan Faaliyetler Sohbet

Atanan Sorular

Metin	Kategori	Cevap	tarih	Ağırlık	Aktivite
Kendisine dokunulmasına izin verir.	Sözel Olmayan İletişim	4	2019-03-03	10	
Başının okşanmasına izin verir.	Sözel Olmayan İletişim	4	2019-03-03	10	
Elinin tutulmasına izin verir.	Sözel Olmayan İletişim	4	2019-03-03	10	
İstendiğinde başkasının elini tutar	Sözel Olmayan İletişim	4	2019-03-03	10	
El ele tutuşularak oynanan oyunlar oynar.	Sözel Olmayan İletişim	4	2019-03-03	10	
Karşısındaki elini uzattığında ona uygun elini uzatır.	Sözel Olmayan İletişim	4	2019-03-03	10	
Karşısındaki elini tutar.	Sözel Olmayan İletişim	4	2019-03-03	10	
Karşısındaki ile tokalaşma hareketini yapar.	Sözel Olmayan İletişim	4	2019-03-03	10	
Karşısındakine elini uzatır.	Sözel Olmayan İletişim	4	2019-03-03	10	
Karşısındaki ile selâmlaşmak için tokalaşma hareketini yapar.	Sözel Olmayan İletişim	3	2019-03-03	10	
Bir elini baş hizasında tutarak sağa sola sallar.	Sözel Olmayan İletişim	4	2019-03-03	10	
Vedalaşırken elini sallar.	Sözel Olmayan İletişim	4	2019-03-03	10	
Gösterildiğinde dudaklarını birbirine sürter.	Sözel Olmayan İletişim	4	2019-03-03	10	
Gösterildiğinde dudaklarını büzer.	Sözel Olmayan İletişim	4	2019-03-03	10	
Gösterildiğinde öpme hareketi yapar.	Sözel Olmayan İletişim	3	2019-03-03	10	
Gösterildiğinde dilini dudağının üzerinde hareket ettirir.	Sözel Olmayan İletişim	3	2019-03-03	10	
Gösterildiğinde parmakla dudağında "sus" işaretini yapar.	Sözel Olmayan İletişim	4	2019-03-03	10	
Gösterildiğinde kaşlarını çatır.	Sözel Olmayan İletişim	4	2019-03-03	10	
Gösterildiğinde gülme hareketini yapar.	Sözel Olmayan İletişim	4	2019-03-03	10	

Gösterildiğinde, sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz ifadelerini taklit eder.	Sözel Olmayan İletişim	3	2019-03-03	10	
Sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz ifadelerini resimli kartlardan gösterir/söyler.	Sözel Olmayan İletişim	2	2019-03-03	10	Etkinlik Ata
İstendiğinde sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz hareketlerini yapar.	Sözel Olmayan İletişim	1	2019-03-03	10	Etkinlik Ata
İstendiğinde bildiği ve hoşuna giden sesleri çıkarır.	Sözel İletişim	3	2019-03-03	10	
Verilen yeni seslerin kaynağını söyler.	Sözel İletişim	3	2019-03-03	10	
Kaynağı söylenen sesleri çıkarır. (dağa, araç, hayvan vb.).	Sözel İletişim	3	2019-03-03	10	
Müzik sesini dinler.	Sözel İletişim	4	2019-03-03	10	
Dinlediği sesin "müzik sesi" olduğunu söyler.	Sözel İletişim	4	2019-03-03	10	
Müzik sesini taklit eder.	Sözel İletişim	2	2019-03-03	10	Etkinlik Ata
Dinlediği iki farklı ses arasından "müzik sesini" ayırt eder.	Sözel İletişim	4	2019-03-03	10	
Çevresinde duyduğu sesler arasından "müzik sesini" ayırt eder.	Sözel İletişim	4	2019-03-03	10	
İstemediği bir içecek, yiyecek veya nesne verildiğinde başını arkaya ya da sağa-sola sallayarak reddettiğini gösterir.	Sözel İletişim	4	2019-03-03	10	
İstemediği bir içecek, yiyecek veya nesne verildiğinde başını arkaya ya da sağa-sola sallayarak "hayır" der.	Sözel İletişim	4	2019-03-03	10	
İstemediği nesne ve olaylarla karşılaştığında reddettiğini belirtmek için "hayır" sözcüğünü kullanır.	Sözel İletişim	4	2019-03-03	10	
İsteddiği bir içecek, yiyecek veya nesne verilmeden önce "İstiyor musun?" sorusu sorulduğunda başını öne-arkaya sallar.	Sözel İletişim	4	2019-03-03	10	
İsteddiği bir içecek, yiyecek veya nesne verilmeden önce "İstiyor musun?" sorusu sorulduğunda başını öne-arkaya sallayarak "evet" der.	Sözel İletişim	4	2019-03-03	10	
İsteddiği nesne ve olaylarla karşılaştığında, isteğini ve onayladığını belirtmek için "evet" sözcüğünü kullanır.	Sözel İletişim	4	2019-03-03	10	
"Evet" veya "hayır" ile yanıtlanabilen sorulara cevap verir.	Sözel İletişim	4	2019-03-03	10	
Geraktığında "evet" ve "hayır" sözcüklerini yerinde kullanır.	Sözel İletişim	4	2019-03-03	10	
Gösterilen nesnenin adını söyler.	Sözel İletişim	4	2019-03-03	10	
Adı söylenen nesneyi gösterir.	Sözel İletişim	4	2019-03-03	10	
Resimli karttaki nesneyi gösterir/söyler.	Sözel İletişim	4	2019-03-03	10	
İki resim arasında adı söylenen resmi gösterir/söyler.	Sözel İletişim	4	2019-03-03	10	

Dört veya daha fazla resim arasında adı söylenen resmi gösterir/söyler.	Sözel İletişim	4	2019-03-03	10	
Karışık olarak verilen resimli kartlardaki nesnelere gösterir/söyler.	Sözel İletişim	2	2019-03-03	10	Etkinlik Ata
Etkinlik sırasında yaptığı iş söylendiğinde söyleneni tekrar eder.	Sözel İletişim	3	2019-03-03	10	
"Şimdi ne yapıyorsunuz?" sorusuna en az iki ya da üç sözcükle cevap verir.	Sözel İletişim	1	2019-03-03	10	Etkinlik Ata
Ne yapmak istediğini basit sözcüklerle söyler.	Sözel İletişim	2	2019-03-03	10	Etkinlik Ata
Tek sözcüklü komutları yerine getirir. (gel, git, al, ver vb.)	İletişim	4	2019-03-03	10	
İki eylemli komutları yardımıyla yerine getirir. (kalemi al gel, çöpü al at vb.)	İletişim	3	2019-03-03	10	
İki eylemli komutları öğretmen kontrolünde yerine getirir.	İletişim	3	2019-03-03	10	
İki eylemli komutları bağımsız olarak yerine getirir.	İletişim	2	2019-03-03	10	Etkinlik Ata
Birden fazla olay anlatan resim kartındaki nesnelere gösterir/söyler.	İletişim	2	2019-03-03	10	Etkinlik Ata
Birden fazla olay anlatan resim kartındaki kişileri gösterir/söyler.	İletişim	4	2019-03-03	10	
Birden fazla olay anlatan resim kartındaki olayları sorular yardımıyla anlatır.	İletişim	2	2019-03-03	10	Etkinlik Ata
Birden fazla olay anlatan resim kartındaki olayları tek tek anlatır.	İletişim	2	2019-03-03	10	Etkinlik Ata
Birden fazla olay anlatan resim kartındaki kompozisyonu anlatır.	İletişim	1	2019-03-03	10	Etkinlik Ata
Öyküyü dinlediğini jest ve mimikleriyle belli eder.	İletişim	3	2019-03-03	10	
Soru sorulduğunda öykünün adını söyler.	İletişim	3	2019-03-03	10	
Soru sorulduğunda öyküdeki kişileri gösterir/söyler.	İletişim	4	2019-03-03	10	
Soru sorulduğunda öyküdeki olayları tek tek gösterir/söyler.	İletişim	1	2019-03-03	10	Etkinlik Ata
İstendiğinde öyküyü anlatır.	İletişim	1	2019-03-03	10	Etkinlik Ata
Kendisini gösterir/söyler.	İletişim	4	2019-03-03	10	
Kendisini iki kişi arasından (aynada, resimde) gösterir.	İletişim	4	2019-03-03	10	
Sabah kalktıktan sonra yaptıklarını söyler.	İletişim	2	2019-03-03	10	Etkinlik Ata
Okulda yaptıklarını söyler.	İletişim	2	2019-03-03	10	Etkinlik Ata

Okulda yaptıklarını söyler.	İletişim	2	2019-03-03	10	Etkinlik Ata
Evde yatıncaya kadar yaptıklarını söyler.	İletişim	2	2019-03-03	10	Etkinlik Ata
Hafta sonunda yaptıklarını söyler.	İletişim	2	2019-03-03	10	Etkinlik Ata
Resimli kartlarda gördüklerini söyler.	İletişim	4	2019-03-03	10	
Resimli kartlardaki olayları anlatır.	İletişim	3	2019-03-03	10	
Karışık olarak verildiğinde en az üç resimli kartı olay sırasına göre dizer.	İletişim	2	2019-03-03	10	Etkinlik Ata
Sıraya dizdiği resimli kartlardaki olayları başından sonuna kadar öykü şeklinde anlatır.	İletişim	3	2019-03-03	10	
Tek hareketli basit bir olayı izler.	İletişim	3	2019-03-03	10	
Sorular yöneltildiğinde olayı anlatır.	İletişim	2	2019-03-03	10	Etkinlik Ata
Sorulduğunda olayın sonucunu söyler.	İletişim	2	2019-03-03	10	Etkinlik Ata
Benzer bir olayı izler.	İletişim	2	2019-03-03	10	Etkinlik Ata
Sorulduğunda olayın sonunda ne olacağını söyler.	İletişim	1	2019-03-03	10	Etkinlik Ata
Adı söylendiğinde bakar.	İletişim	4	2019-03-03	10	
Karşısındaki kişi ile bir süre göz kantağı kurar.	İletişim	4	2019-03-03	10	
Kendisiyle konuşan kişinin gözlerini ve ağızını izleyerek yüzüne bakar.	İletişim	4	2019-03-03	10	

Kendisiyle konuşan kişiyi dinlediğini jest ve mimiklerle belli eder.	İletişim	4	2019-03-03	10	
Karşısındaki kişinin sorularına cevap verir.	İletişim	4	2019-03-03	10	
Karşısında konuşan kişiyi dinler.	İletişim	3	2019-03-03	10	
Kendisine yöneltilen "evet" veya "hayır" cevaplı sorulara cevap verir.	İletişim	4	2019-03-03	10	
Kendisine yöneltilen sorulara basit cümleler kurarak cevap verir.	İletişim	2	2019-03-03	10	Etkinlik Ata
Karşısındaki anlamlı sorular sorar.	İletişim	3	2019-03-03	10	
Karşısındaki ile 3-5 dk sohbet eder.	İletişim	2	2019-03-03	10	Etkinlik Ata
Konu ve günlük hayatı ile ilgili konular üzerinde 3-5 dk konuşur.	İletişim	2	2019-03-03	10	Etkinlik Ata
Kendisi ile ilgili konularda "ben" sözcüğünü kullanır.	İletişim	4	2019-03-03	10	
Karşısındaki göstererek "sen" der.	İletişim	4	2019-03-03	10	
Karşısındaki ile ilgili konularda "sen" sözcüğünü kullanır.	İletişim	4	2019-03-03	10	
Karşısındaki başkasını göstererek "o" der.	İletişim	4	2019-03-03	10	
Karşısındaki başkasından söz ederken "o" sözcüğünü kullanır.	İletişim	4	2019-03-03	10	
"Ben, sen, o" sözcüklerini yerinde kullanır.	İletişim	4	2019-03-03	10	
Metin	Kategori	Cevap	tarih	Ağırlık	Aktivite

© 2018 Autism Specialist. EMU.

Figure 48. Evaluation Results of Assigned Questions to Parents.

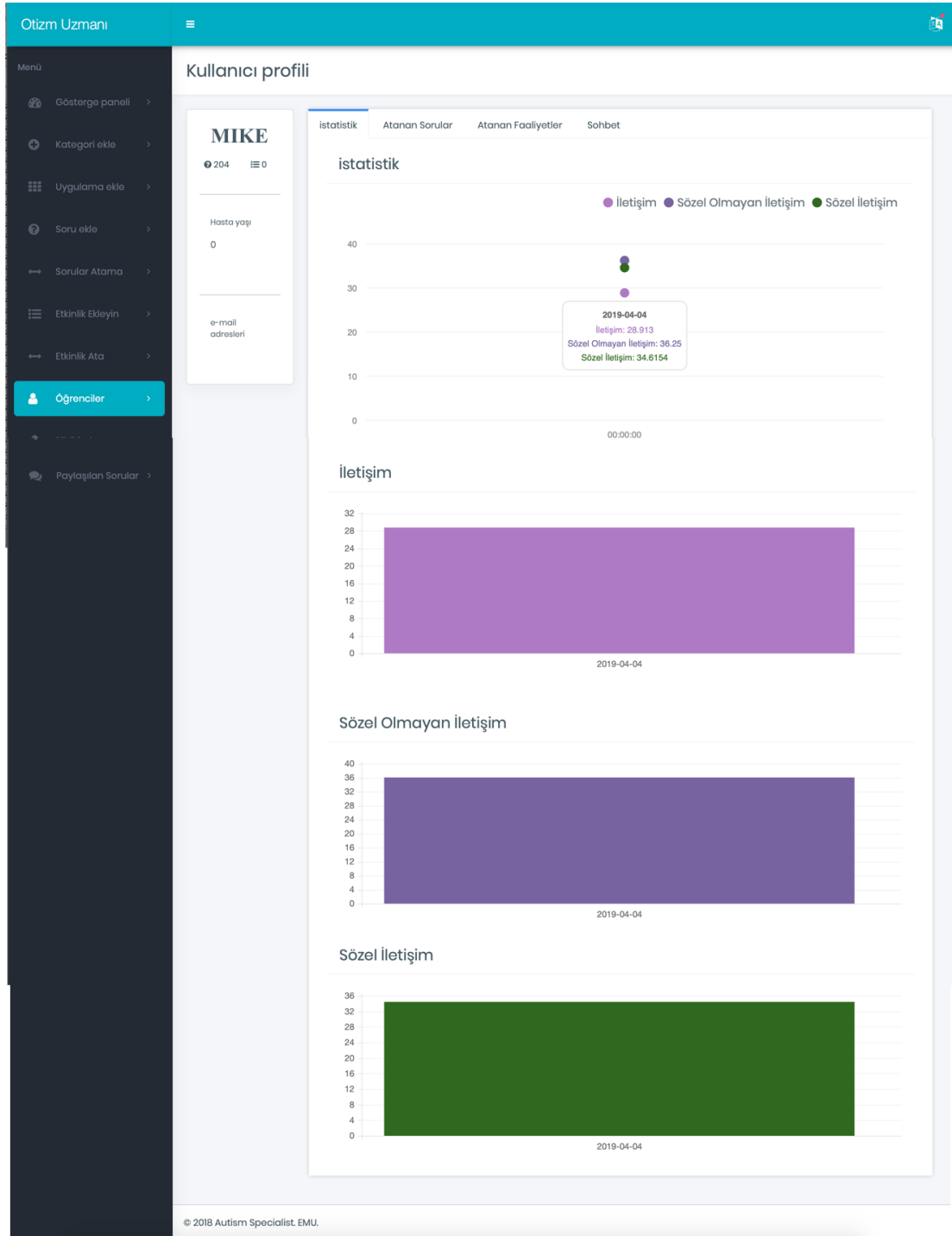


Figure 49. Result Statistics of Questions.

Inside the mobile application parents can see the statistics also after answering the questions assessment screen will display the statistics (Figure 50) in chart mode and categories base on the question's category.

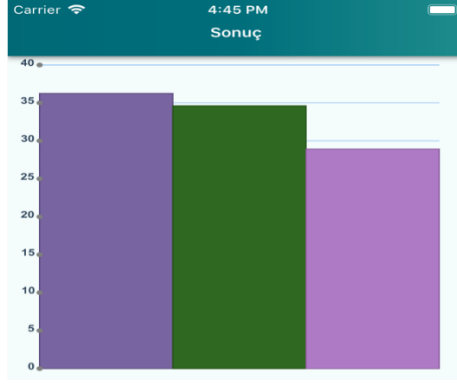


Figure 50. Statistics on Mobile Application

Parents can click on each category box to show the detail information related to each category, they can see activity assigned, appropriate games and all the questions with answers related to clicked box category (Figure 51).






Carrier 1:51 AM		Carrier 4:45 PM		Carrier 4:45 PM	
Sözel Olmayan İletişim		Sözel Olmayan İletişim		Sözel Olmayan İletişim	
Faaliyetler	Oyunlar	Sorular	Faaliyetler	Oyunlar	Sorular
DOKUN SÖYLE KATILIMCILAR: Çocuk, Aile, Arkadaş		 Proloquo2Go Symbol ba... \$249.99 Proloquo2Go is an award... iPad Only Communication	15	Gösterildiğinde öpme hareketi yapar.	3
SENİ GİDİ SENİ KATILIMCILAR: Çocuk, Aile, Arkadaş MATERYALLER: Çocuğunuzun en sevdiği insan ya da hayvan olan başlı oyuncaklarından 2 ve daha fazlası		 iPACS \$29.99 Please visit www.adastra... iPod & iPad Communication	16	Gösterildiğinde dilini dudağının üzerinde hareket ettirir.	3
EN GÜÇLÜ KİM? KATILIMCILAR: Çocuk, Aile, Arkadaş		 MyTalkTools Mobile \$99.99 MyTalkTools Mobile for t... iPad Only Communication	17	Gösterildiğinde parmakla dudağında "sus" işaretini yapar.	4
ELDEKİ ÇOCUKLARI TUTMACA KATILIMCILAR: Çocuk, Aile, Arkadaş MATERYALLER: Ellerinizin üzerine ya da avuç içinize 2-3 cm çaplı kız ve erkek çocuk gülen yüzü çiziniz.		 Voice4u AAC Communic... \$59.99 Voice4u is an simple app... iPad Only Communication	18	Gösterildiğinde kaşlarını çatar.	4
AÇIL ÇİÇEK AÇIL KAPAN KATILIMCILAR: Çocuk, Aile, Arkadaş		 iComm Free Picture and voice comm... iPad & iPad	19	Gösterildiğinde gülme hareketini yapar.	4
SEN YAPAMAZSIN KATILIMCILAR: Çocuk, Aile, Arkadaş MATERYALLER: Avuç			20	Gösterildiğinde, sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz ifadelerini taklit eder.	3
			21	Sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz ifadelerini resimli kartlardan gösterir/söyler.	2
			22	İstendiğinde sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz hareketlerini yapar.	1
			Soru Sayısı		22
			2 Puandan Fazla Sorular		2

Figure 51. Mobile Application Detail Information Base on Categories

Mike parent can choose from the suggestion game list, one of the game base on the description, review and etc, install the game and let Mike play with that game for a while.

Autism Teacher can see the statistics from the admin panel, based on the answers of parent for each question (answers less than 3 point) system enabled the button for assigning the appropriate activities (Figure 52), then autism teachers can decide which one the patient need and assign that one to the parent phone in the autism application (Figure 53).

Gösterildiğinde, sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz ifadelerini taklit eder.	Sözel Olmayan İletişim	3	2019-03-03	10	
Sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz ifadelerini resimli kartlardan gösterir/söyler.	Sözel Olmayan İletişim	2	2019-03-03	10	Activity Assigned
İstendiğinde sevinç, üzüntü, kızgınlık, ağlama vb. temel duyguları belirten yüz hareketlerini yapar.	Sözel Olmayan İletişim	1	2019-03-03	10	Activity Assigned
İstendiğinde bildiği ve hoşuna giden sesleri çıkarır.	Sözel İletişim	3	2019-03-03	10	
Verilen yeni seslerin kaynağını söyler.	Sözel İletişim	3	2019-03-03	10	
Kaynağı söylenen sesleri çıkarır. (doğa, araç, hayvan vb.).	Sözel İletişim	3	2019-03-03	10	
Müzik sesini dinler.	Sözel İletişim	4	2019-03-03	10	
Dinlediği sesin "müzik sesi" olduğunu söyler.	Sözel İletişim	4	2019-03-03	10	
Müzik sesini taklit eder.	Sözel İletişim	2	2019-03-03	10	Assign Activity

Figure 52. Assigned-Question Screen in Admin Panel



Figure 53. Mobile Application Activities Assigned Screen.

Mike's parents will start to perform the activities on Mike everyday continuously until 2 weeks and if they have any questions they can share it in chat section with autism teacher, autism teacher also can respond them from the admin panel. After 2 weeks autism teacher will assign the new questions from admin panel and parents should answer the new question in order to see the improvements. This cycle will perform until autism teacher can see the improvements in patient's problematic skills.

During the test process at first steps parent had face little bit difficulties in order to install the application on their phone and the reason was the application is not published on apple and android stores yet then we used the deployment Appcenter

approach for getting the mobile phone serial numbers and register it in stores. After installation they had comfortable feeling during the assessment and answering the questions process. They could easily find the assigned activities, read them and performed them on their children. They were being happy with push notification system which notify them when they have assigned questions and activities.

Instructor starts to use his/her instructor account from instructor panel and can assign the activities to parents. They mentioned the interface easy and user friendly to work with, they were happy with the system being responsive and can be used in the phone browsers.

Chapter 6

CONCLUSION

ADS children are not like other sicknesses which doctors can cure them with some pills or injections or surgeries, it is really complicated and needs lots of time and knowledge to improve their sickness and make them normal.

We should always remember early detection in ADS will make the cure process fast and ADS is a kind of sickness which is hard to detect in childhood and first ages but parents should always aware about the signs of this disease and know how to detect and assessment.

This is the point which give us this idea to give an automated tool available to parents and teachers which connect them easily and make lots of training and assessment automatic that helps to speed, time and accuracy.

We used the newest technology and methodology to create a system which is work on mobile devices. Which can bring all the ASD specialists, teachers, children and parent cooperate and communicate easily with each other. Proposed system tried to used games and physical activities which is excited to children to play and at the same time these games and physical activities can improve their problematic skills.

We believe with this system after some years and have some real data it can really helpful to all those ASD children and their parent which praying every day to see their children like normal ones, teachers and doctors can use the real data and data minding on system results on theirs studies to achieve new knowledge and strategies which give us more hope to find the solution for curing all ASD children.

As future studies, there is a possibility to add Artificial Intelligent (AI) in this system which can understand automatically which solution and activities will be more helpful in improving the skills from the data gathered in some years maybe thousands of peoples which used the system.

REFERENCES

- [1] American Psychiatric Association: Diagnostic and statistical manual of mental disorders, 5th edn. American Psychiatric Publishing, Arlington, VA (2013)
- [2] American Psychiatric Publishing: what is autism spectrum disorder? <https://goo.gl/pKX8IZ> (2016)
- [3] Christensen, D.L., Baio, J., Braun, K.V.N., et al.: Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012. Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C. : 2002) 65(3) (2014) 1–23
- [4] Oliveira, G., Ata'ide, A., Marques, C., et al.: Epidemiology of autism spectrum disorder in portugal: prevalence, clinical characterization, and medical conditions. *Dev. Med. Child Neurol.* 49(10), 726–733 (2007)
- [5] Goldsmith, T., LeBlanc, L.: Use of technology in interventions for children with autism. *J. Early Intensive Behav.* 1(2), 166–178 (2004)
- [6] Corti K. Games-based business & management skills development. White Paper. 2001. http://www.pixelearning.com/docs/justifying_games_for_learning.pdf

- [7] Gal, E., Bauminger, N., Goren-Bar, D., Pianesi, F., Stock, O., Zancanaro, M., & et al. Enhancing social communication of children with high-functioning autism through a co-located interface. *Artificial Intelligence and Society*, 24(1), 75-84. 2009.
- [8] Barakova, E., Gillessen, J., & Feijis, L. Social training of autistic children with interactive intelligent agents. *Journal of Integrative Neuroscience*, 8(1), 23-34. 2009.
- [9] American Psychiatric Association, “Autism Spectrum Disorder Fact Sheet.” <http://www.dsm5.org/Documents/AutismSpectrumDisorderFactSheet.pdf>
- [10] M. L. Barton, T. Dumont-Mathieu, and D. Fein, “Screening Young Children for Autism Spectrum Disorders in Primary Practice,” *Journal of Autism and Developmental Disorders*, vol. 42, no. 6, pp. 1165–1174, 2012.
- [11] A. Jevtic, “11 Countries with the Highest Rates of Autism in the World.” <http://goo.gl/HlzYxu>
- [12] Centers for Disease Control and Prevention, “Data and Statistics—Autism Spectrum Disorder (ASD).” <http://www.cdc.gov/ncbddd/autism/data.html>
- [13] N. Haglund, S. Dahlgren, K. Källén, P. Gustafsson, and M. Råstam, “The Observation Scale for Autism (OSA): A New Screening Method to Detect

Autism Spectrum Disorder before Age Three Years,” *Journal of Intellectual Disability-Diagnosis and Treatment*, vol. 3, pp. 230–237, 2015.

[14] S. Ehlers, C. Gillberg, and L. Wing, “A screening questionnaire for Asperger syndrome and other high-functioning autism spectrum disorders in school age children,” *Journal of Autism and Developmental Disorders*, vol. 29, no. 2, pp. 129–141, 1999 open, 6(11), e012135.

[15] J. M. Eriksson, L. M. Andersen, and S. Bejerot, “Raads-14 screen: validity of a screening tool for autism spectrum disorder in an adult psychiatric population,” *Molecular Autism*, vol. 4, no. 1, pp. 1–11, 2013.

[16] Apple Incorporation and Duke Medicine, “Autism & Beyond.”
<https://autismandbeyond.researchkit.duke.edu/>

[17] Autism Canada, “Autism Canada—See the Spectrum Differently.”
<http://autismcanada.org/>

[18] P. S. Dehkordi, H. Moradi, M. Mahmoudi, and H. R. Pouretamad, “The design, development, and deployment of roboparrot for screening autistic children,” *International Journal of Social Robotics*, vol. 7, no. 4, pp. 513–522, 2015.

[19] Al Mamun, K. A., Bardhan, S., Ullah, M. A., Anagnostou, E., Brian, J., Akhter, S., & Rabbani, M. G. (2016, August). Smart autism—A mobile, interactive and integrated framework for screening and confirmation of autism. In *Engineering*

in Medicine and Biology Society (EMBC), 2016 IEEE 38th Annual International Conference of the (pp. 5989-5992). IEEE.

[20] Bonnot, O., Bonneau, D., Doudard, A., & Duverger, P. (2016). Rationale and protocol for using a smartphone application to study autism spectrum disorders: SMARTAUTISM. *BMJ open*, 6(11), e012135.

[21] Onesignal (2019, May 6). Retrieved from <https://onesignal.com>

APPENDICES

Appendix A: DMS-5 Evaluation

1. Somatic Symptoms
2. Sleep Problems
3. Inattention
4. Depression
5. Anger
6. Irritability
7. Mania
8. Anxiety
9. Psychosis
10. Repetitive Thoughts & Behaviors
11. Substance Use
12. Suicidal Ideation/ Suicide Attempts
13. Anger and Irritability
14. Cause and Effect
15. Communication
16. Fine Motor and Writing Skills
17. Depression
18. Inattention
19. Somatic and Symptoms
20. School and Work
21. Self and Care
22. Sensory
23. Speech and Language

24. Anxiety

25. Behavior and Social Skills

Level 1 DSM 5 Questions Lists for Parent

	During the past TWO (2) WEEKS , how much (or how often) has your child...	None Not at all	Slight Rare, less than a day or two	Mild Several days	Moderate More than half the days	Severe Nearly every day	
Somatic Symptoms	1.	Complained of stomachaches, headaches, or other aches and pains?	0	1	2	3	4
	2.	Said he/she was worried about his/her health or about getting sick?	0	1	2	3	4
Sleep Problems	3.	Had problems sleeping—that is, trouble falling asleep, staying asleep, or waking up too early?	0	1	2	3	4
Inattention	4.	Had problems paying attention when he/she was in class or doing his/her homework or reading a book or playing a game?	0	1	2	3	4
Depression	5.	Had less fun doing things than he/she used to?	0	1	2	3	4
	6.	Seemed sad or depressed for several hours?	0	1	2	3	4
Anger & Irritability	7.	Seemed more irritated or easily annoyed than usual?	0	1	2	3	4
	8.	Seemed angry or lost his/her temper?	0	1	2	3	4
Mania	9.	Started lots more projects than usual or did more risky things than usual?	0	1	2	3	4
	10.	Slept less than usual for him/her, but still had lots of energy?	0	1	2	3	4
Anxiety	11.	Said he/she felt nervous, anxious, or scared?	0	1	2	3	4
	12.	Not been able to stop worrying?	0	1	2	3	4
	13.	Said he/she couldn't do things he/she wanted to or should have done, because they made him/her feel nervous?	0	1	2	3	4

Psychosis	14.	Said that he/she heard voices—when there was no one there—speaking about him/her or telling him/her what to do or saying bad things to him/her?	0	1	2	3	4
	15.	Said that he/she had a vision when he/she was completely awake—that is, saw something or someone that no one else could see?	0	1	2	3	4
Repetitive Thoughts and Behaviors	16.	Said that he/she had thoughts that kept coming into his/her mind that he/she would do something bad or that something bad would happen to him/her or to someone else?	0	1	2	3	4
	17.	Said he/she felt the need to check on certain things over and over again, like whether a door was locked or whether the stove was turned off?	0	1	2	3	4
	18.	Seemed to worry a lot about things he/she touched being dirty or having germs or being poisoned?	0	1	2	3	4
	19.	Said that he/she had to do things in a certain way, like counting or saying special things out loud, in order to keep something bad from happening?	0	1	2	3	4
Substance Use	20.	Had an alcoholic beverage (beer, wine, liquor, etc.)?	0	1	2	3	4
	21.	Smoked a cigarette, a cigar, or pipe, or used snuff or chewing tobacco?	0	1	2	3	4
	22.	Used drugs like marijuana, cocaine or crack, club drugs (like ecstasy), hallucinogens (like LSD), heroin, inhalants or solvents (like glue), or	0	1	2	3	4

		methamphetamine (like speed)?					
	23.	Used any medicine without a doctor's prescription (e.g., painkillers [like Vicodin], stimulants [like Ritalin or Adderall], sedatives or tranquilizers [like sleeping pills or Valium], or steroids)?	0	1	2	3	4
Suicidal Ideation/ Suicide Attempts	24.	In the past TWO (2) WEEKS , has he/she talked about wanting to kill himself/herself or about wanting to commit suicide?	0	1	2	3	4
	25.	Has he/she EVER tried to kill himself/herself?	0	1	2	3	4
Nonverbal communication	26.	He/She is in bodily/physical contact.	0	1	2	3	4
	27.	Makes the movements used to salute and say goodbye.	0	1	2	3	4
	28.	Simulates facial movements.	0	1	2	3	4
	29.	Makes basic emotions (enjoy, sadness, anger, crying, etc.) via face movements.	0	1	2	3	4
Verbal communication	30.	Simulates voices/sounds.	0	1	2	3	4
	31.	Distinguishes voices/sounds.	0	1	2	3	4
	32.	Uses "yes", "no" signs and words in correct place.	0	1	2	3	4
	33.	Names the objects shown on the picture/illustrated cards.	0	1	2	3	4
	34.	Refers to the his/her requirements with simple words.	0	1	2	3	4
-Communication	35.	Fulfills the commands declaring two actions.	0	1	2	3	4
	36.	Describes the events in the picture.	0	1	2	3	4
	37.	Describes illustrated stories.	0	1	2	3	4
	38.	Tells you the characteristics of his/her own body.	0	1	2	3	4

	39.	Describes a day with simple expressions.	0	1	2	3	4
	40.	Describes at least three consecutive pictures in the form of a story.	0	1	2	3	4
	41.	Predicts the outcome of a simple event.	0	1	2	3	4
	42.	Listens to the person who spoke to him.	0	1	2	3	4
	43.	He/She speaks 3-5 minutes about a topic.	0	1	2	3	4
	44.	Uses pronouns in place..	0	1	2	3	4

Level 2 DSM 5 Questions

		None Not at all	Slight Rare, less than a day or two	Mild Several days	Moderate More than half the days	Severe Nearly every day
1.	His/her sleep was restless.	0	1	2	3	4
2.	He/she was satisfied with his/her sleep.	0	1	2	3	4
3.	His/her sleep was refreshing.	0	1	2	3	4
4.	He/she had difficulty falling asleep.	0	1	2	3	4
5.	He/she had trouble staying asleep.	0	1	2	3	4
6.	He/she had trouble sleeping.	0	1	2	3	4
7.	He/she got enough sleep.	0	1	2	3	4
8.	His/her sleep quality was...	0	1	2	3	4
9.	Stomach pain	0	1	2	3	4
10.	Back pain	0	1	2	3	4
11.	Pain in his or her arms, legs, or joints (knees, hips, etc.)	0	1	2	3	4
12.	Headaches	0	1	2	3	4
13.	Chest pain	0	1	2	3	4
14.	Dizziness	0	1	2	3	4
15.	Fainting spells	0	1	2	3	4
16.	Feeling his or her heart pound or race	0	1	2	3	4
17.	Shortness of breath	0	1	2	3	4
18.	Constipation, loose bowels, or diarrhea	0	1	2	3	4
19.	Nausea, gas, or indigestion	0	1	2	3	4
20.	Feeling tired or having low energy	0	1	2	3	4

21.	Trouble sleeping	0	1	2	3	4
22.	Stomach pain	0	1	2	3	4
23.	Back pain	0	1	2	3	4
24.	Pain in his or her arms, legs, or joints (knees, hips, etc.)	0	1	2	3	4
25.	Headaches	0	1	2	3	4
26.	Chest pain	0	1	2	3	4
27.	Dizziness	0	1	2	3	4
28.	Fainting spells	0	1	2	3	4
29.	Feeling his or her heart pound or race	0	1	2	3	4
30.	Shortness of breath	0	1	2	3	4
31.	Constipation, loose bowels, or diarrhea	0	1	2	3	4
32.	Nausea, gas, or indigestion	0	1	2	3	4
33.	Feeling tired or having low energy	0	1	2	3	4
34.	Trouble sleeping	0	1	2	3	4
35.	Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities.	0	1	2	3	4
36.	Often has difficulty sustaining attention in tasks or play activities.	0	1	2	3	4
37.	Often does not seem to listen when spoken to directly.	0	1	2	3	4
38.	Often does not follow through on instructions and fails to finish schoolwork, chores, or duties.	0	1	2	3	4
39.	Often has difficulty organizing tasks and activities.	0	1	2	3	4
40.	Often avoids, dislikes, or is reluctant to engage in tasks that require sustained	0	1	2	3	4

	mental effort (e.g., schoolwork or homework).					
41.	Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools.)	0	1	2	3	4
42.	Often is distracted by extraneous stimuli.	0	1	2	3	4
43.	Could not stop feeling sad.	0	1	2	3	4
44.	Felt alone.	0	1	2	3	4
45.	Felt like he/she couldn't do anything right.	0	1	2	3	4
46.	Felt lonely.	0	1	2	3	4
47.	Felt sad.	0	1	2	3	4
48.	Felt unhappy.	0	1	2	3	4
49.	Thought that his/her life was bad.	0	1	2	3	4
50.	Didn't care about anything.	0	1	2	3	4
51.	Felt stressed.	0	1	2	3	4
52.	Felt too sad to eat.	0	1	2	3	4
53.	Wanted to be by himself/herself.	0	1	2	3	4
54.	My child felt mad.	0	1	2	3	4
55.	My child was so angry he/she felt like yelling at somebody.	0	1	2	3	4
56.	My child was so angry he/she felt like throwing something.	0	1	2	3	4
57.	My child felt upset.	0	1	2	3	4
58.	When my child got mad, he/she stayed mad.	0	1	2	3	4
59.	Is easily annoyed by others.	0	1	2	3	4
60.	Often loses his/her temper.	0	1	2	3	4
61.	Stays angry for a long time.	0	1	2	3	4

62.	Is angry most of the time.	0	1	2	3	4
63.	Gets angry frequently.	0	1	2	3	4
64.	Loses temper easily.	0	1	2	3	4
65.	Overall irritability causes him/her problems.	0	1	2	3	4
66.	Felt like something awful might happen.	0	1	2	3	4
67.	Felt nervous.	0	1	2	3	4
68.	Felt scared.	0	1	2	3	4
69.	Felt worried.	0	1	2	3	4
70.	Worried about what could happen to him/her.	0	1	2	3	4
71.	Worried when he/she went to bed at night.	0	1	2	3	4
72.	Got scared really easy.	0	1	2	3	4
73.	Was afraid of going to school.	0	1	2	3	4
74.	Worried when he/she was at home.	0	1	2	3	4
75.	Worried when he/she was away from home.	0	1	2	3	4
76.	Have an alcoholic beverage (beer, wine, liquor, etc.)?	0	1	2	3	4
77.	Have 4 or more drinks in a single day?	0	1	2	3	4
78.	Smoke a cigarette, a cigar, or pipe or used snuff or chewing tobacco?	0	1	2	3	4
79.	Painkillers (like Vicodin)	0	1	2	3	4
80.	Stimulants (like Ritalin, Adderall)	0	1	2	3	4
81.	Sedatives or tranquilizers (like sleeping pills or Valium)	0	1	2	3	4
82.	Steroids	0	1	2	3	4

83.	Other medicines	0	1	2	3	4
84.	Marijuana	0	1	2	3	4
85.	Cocaine or crack	0	1	2	3	4
86.	Club drugs (like ecstasy)	0	1	2	3	4
87.	Hallucinogens (like LSD)	0	1	2	3	4
88.	Heroin	0	1	2	3	4
89.	Inhalants or solvents (like glue)	0	1	2	3	4
90.	Methamphetamine (like speed)	0	1	2	3	4

Appendix B: MEB Evaluation

		None Not at all	Slight Rare, less than a day or two	Mild Several days	Moderate More than half the days	Severe Nearly every day
1.	Allows him to be touched.	0	1	2	3	4
2.	The child allows the head to be stroked.	0	1	2	3	4
3.	The child allows his hand to be held.	0	1	2	3	4
4.	Holds someone else's hand when you asked.	0	1	2	3	4
5.	Plays the games played by holding hands.	0	1	2	3	4
6.	When a person reaches out his hand to him, he reaches his appropriate hand towards to the person.	0	1	2	3	4
7.	Holds the hand of the opposite.	0	1	2	3	4
8.	.He makes a handshake gesture with the other person.	0	1	2	3	4
9.	Extends his hand to the person.	0	1	2	3	4
10.	Holds the hand of the person.	0	1	2	3	4
11.	Standing against the person makes handshake.	0	1	2	3	4
12.	Makes a handshake gesture to salute with the person standing against.	0	1	2	3	4
13.	Holds one hand at head level, and swings to the left-right.	0	1	2	3	4
14.	While saying goodbye, waving hands	0	1	2	3	4
15.	When he is shown, he rubs his lips together.	0	1	2	3	4
16.	When shown, it purse up her/his lips.	0	1	2	3	4
17.	When shown, makes A kissing gesture.	0	1	2	3	4

18.	When shown, it moves the tongue over the lip.	0	1	2	3	4
19.	When shown, he makes a "hush" sign on his lip with his finger.	0	1	2	3	4
20.	When shown, makes the eyebrows crack.	0	1	2	3	4
21.	When shown, it acts as A laughing gesture.	0	1	2	3	4
22.	When shown, it simulates facial expressions that indicate basic emotions such as joy, sadness, resection, crying, etc.	0	1	2	3	4
23.	Shows/tells the facial expressions that indicate the basic emotions of joy, sadness, resection, crying, etc. from the illustrated cards.	0	1	2	3	4
24.	When prompted, he/she makes face movements that indicate the basic emotions of joy, sadness, resection, crying, etc	0	1	2	3	4
25.	When you're asked, you can hear the sounds that he/she know and enjoy.	0	1	2	3	4
26.	When you're asked, you can hear the sounds that he/she know and enjoy.	0	1	2	3	4
27.	When you're asked, you can hear the sounds that he/she know and enjoy.	0	1	2	3	4
28.	Makes the sounds that is given with its source of the sound (nature, vehicle, animal, etc.).	0	1	2	3	4
29.	He listens to music.	0	1	2	3	4
30.	He says that the voice he listens to is the sound of music	0	1	2	3	4
31.	Simulates the sound of music.	0	1	2	3	4
32.	.Distinguishes the "sound of music" from two different sounds.	0	1	2	3	4
33.	Distinguishes the "sound of music" from the sounds he hears around him.	0	1	2	3	4
34.	When he is given a drink, food, or object that he doesn't want, he shows his rejection	0	1	2	3	4

	by turning his head backwards or to the left and right.					
35.	When he is given a drink, food, or object that he doesn't want, he'll say no, shaking his head backwards or to the left and right.	0	1	2	3	4
36.	When she encounters objects and events that she does not want, she uses the word "no" to indicate that she has declined.	0	1	2	3	4
37.	When asked about the "do you want" question before she was given a drink, food, or object, she shakes her head back and forth.	0	1	2	3	4
38.	When asked about the "do you want" question before she was given a drink, food, or object, she shakes her head back and forth and say "yes".	0	1	2	3	4
39.	When he encounters the objects and events he wants, he uses the word "yes" to indicate his request and to approve it.	0	1	2	3	4
40.	Responds to questions that can be answered with "yes" or "no".	0	1	2	3	4
41.	Use "yes" and "no" in correct place when necessary.	0	1	2	3	4
42.	Tells the name of the object being displayed.	0	1	2	3	4
43.	He indicates the object being said.	0	1	2	3	4
44.	Indicates/tells the object on the illustrated card.	0	1	2	3	4
45.	Between two images, he/she can tell the image which is being said.	0	1	2	3	4
46.	Between four or more images, shows and tells the image which is being said its name.	0	1	2	3	4
47.	Shows/tells the objects on the mixed illustrated cards	0	1	2	3	4
48.	During the event, the work is repeated when said the work done.	0	1	2	3	4
49.	For the "What are you doing now?" question, he/she answers it at least using two or three words.	0	1	2	3	4

50.	Can answer the "What do you want to do next?" question.	0	1	2	3	4
51.	Tells you what you want to do with simple words.	0	1	2	3	4
52.	Refers to his requirements with simple words.	0	1	2	3	4
53.	Performs single-word commands. (Come, go, take, give, etc.)	0	1	2	3	4
54.	Performs two-action commands with help. (Get the pencil, take the trash, etc.)	0	1	2	3	4
55.	Performs two-action commands in the teacher's control.	0	1	2	3	4
56.	Performs two-action commands independently.	0	1	2	3	4
57.	Shows/tells the objects on the picture card that describe multiple events	0	1	2	3	4
58.	Shows/tells the people on the picture card that describe multiple events.	0	1	2	3	4
59.	Explains the events on the picture card that describe multiple events with the help of questions.	0	1	2	3	4
60.	Describes the events on the picture card one by one that describe multiple events.	0	1	2	3	4
61.	Describes the composition on the picture card that describes multiple events.	0	1	2	3	4
62.	He listens to the story with gestures and mimics.	0	1	2	3	4
63.	When asked, tells the name of the story.	0	1	2	3	4
64.	When asked, shows/tells the people in the story	0	1	2	3	4
65.	When asked, shows/tells the objects in the story.	0	1	2	3	4
66.	When asked, shows/tells the events one by one in the story.	0	1	2	3	4
67.	When asked, tells the story.	0	1	2	3	4
68.	He/she shows himself/herself.	0	1	2	3	4
69.	He shows himself between two people (in the mirror, in the picture).	0	1	2	3	4

70.	Tells certain physical properties about himself (hair color, gender, etc.).	0	1	2	3	4
71.	He says what he did after he woke up in the morning.	0	1	2	3	4
72.	Says what he did when he came to school.	0	1	2	3	4
73.	He says what he did at school.	0	1	2	3	4
74.	Tells what he did at home until he went to bed.	0	1	2	3	4
75.	Tells what he did until weekend.	0	1	2	3	4
76.	Says what he/she saw on the picture cards.	0	1	2	3	4
77.	Describes the events in the picture cards.	0	1	2	3	4
78.	When at least three illustrated cards are given in mixed order, he/she can sort them by event order.	0	1	2	3	4
79.	After sequencing the picture cards, tells the events in the picture cards from beginning to end as a story.	0	1	2	3	4
80.	It follows only one simple event.	0	1	2	3	4
81.	Tells what he did at home until he went to bed.	0	1	2	3	4
82.	Tells what he did until weekend.	0	1	2	3	4
83.	Says what he/she saw on the picture cards.	0	1	2	3	4
84.	Describes the events in the picture cards.	0	1	2	3	4
85.	When at least three illustrated cards are given in mixed order, he/she can sort them by event order.	0	1	2	3	4
86.	After sequencing the picture cards, tells the events in the picture cards from beginning to end as a story.	0	1	2	3	4
87.	It follows only one simple event.	0	1	2	3	4
88.	Tells the event when the questions are asked.	0	1	2	3	4
89.	When asked, he/she tells the outcome of an event.	0	1	2	3	4

90.	Follows a similar event.	0	1	2	3	4
91.	When asked, it tells what will happen at the end of the event.	0	1	2	3	4
92.	When her/his name is spoken, he/she looks.	0	1	2	3	4
93.	He/she establishes eye contact for a while with the other person.	0	1	2	3	4
94.	He follows the eyes and mouth of the person who is speaking with him and looks at his face.	0	1	2	3	4
96.	He makes clear with signs and gestures to listen to the person who talks to him/her.	0	1	2	3	4
96.	He answers the questions of the other person.	0	1	2	3	4
97.	He listens to the person who speaks.	0	1	2	3	4
98.	Responds to "yes" or "no" answer the questions asked to him.	0	1	2	3	4
99.	Responds by establishing simple sentences to the questions asked to him.	0	1	2	3	4
100.	He asks meaningful questions to someone.	0	1	2	3	4
101.	Chats with someone 3-5 minutes.	0	1	2	3	4
102.	Speaks about the topics related to any subject and daily life.	0	1	2	3	4
103.	He says "I" by showing himself	0	1	2	3	4
104.	He uses the word "I" in matters related to himself.	0	1	2	3	4
105.	Showing the person and says "you."	0	1	2	3	4
106.	Uses the word "you" in a conversation to the person.	0	1	2	3	4
107.	He says "he" by showing someone else.	0	1	2	3	4
108.	He uses the word "he" when he mentions someone else.	0	1	2	3	4
109.	Uses the words "I, you, he/she" in appropriate place.	0	1	2	3	4