



ASSISTments

AUTOMATIC REASSESSMENT & RELEARNING SYSTEM IN ASSISTMENTS 2.0

A MAJOR QUALIFYING PROJECT REPORT SUBMITTED TO THE
FACULTY OF WORCESTER POLYTECHNIC INSTITUTE IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF BACHELOR OF SCIENCE BY

**MICHAEL CAPOBIANCO
GEORGINA CROMWELL
JASON KING
RYAN KIM**

**ADVISED BY
PROFESSOR NEIL HEFFERNAN**



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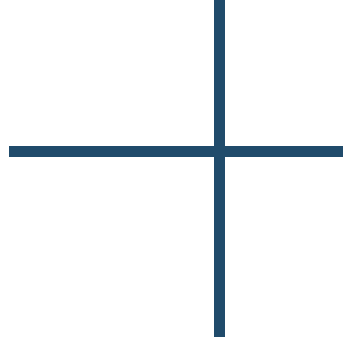
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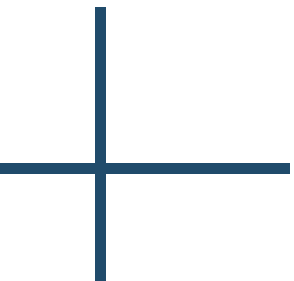


ABSTRACT

This project involved the discovery, design, development, and testing of a new version of ASSISTments' Automatic Reassessment and Relearning System (ARRS). Through the addition of a student landing page, a settings page, and different reports for each class, a minimum viable product was fully implemented in ASSISTments 2.0, which is now compatible with Google Classroom. Feedback from the ASSISTments Teacher Experience Team as well as initial testing with teachers proved the initial MVP was successful in meeting the fundamental requirements of the student and teacher users of ASSISTments and provided insight into possible future changes and improvements.



INTRODUCTION



INTRODUCTION

The goal of this project was to create a minimum viable product of the Automatic Reassessment and Relearning System (ARRS) within ASSISTments 2.0 by implementing and combining key aspects from the existing 1.0 system with current needs of teachers and students. ASSISTments is an online tool designed to give teachers access to a wide variety of content and give students real-time feedback about different assignments. With reports designed to give teachers overviews of each class, assignment, and student, teachers are able to tailor their lesson plans to better fit their students.

This project involved the discovery, design, implementation, and testing of a new version of ASSISTments' ARRS that provides a customizable scheduling system that assesses students on concepts they have mastered to ensure skills are digested and remembered over time. After a thorough analysis of the preliminary code for ARRS in ASSISTments 2.0 and the existing features of ARRS in ASSISTments 1.0, requirements for the new minimum viable product were developed. Through the addition of a student landing page, a settings page, and different report views for assignments and



classes that use ARRS, we were able to fully implement a preliminary

version of the Automatic Reassessment and Relearning System in

ASSISTments 2.0. After initial discussions and testing with the ASSISTments Teacher

Experience Team, the student landing page was adjusted and a second prototype was

developed. Once each feature of ARRS was linked together, the minimum viable

product was tested by two teachers who currently use ARRS in their classrooms.

Feedback from these tests was then incorporated into our second and final version of

ARRS 2.0.

BACKGROUND

BACKGROUND

This section explains the purpose of ASSISTments as a tool for teachers and students as well as the logic behind the Automatic Reassessment and Relearning System.

ASSISTments

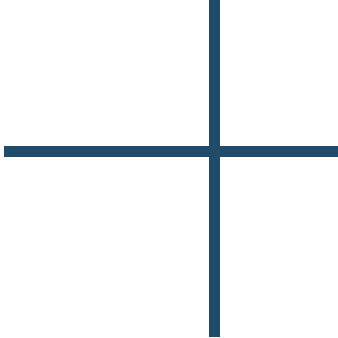
ASSISTments is an online learning tool that enables teachers to assign a variety of online homework problems to their students. It gives users real-time feedback; students receive helpful hints and results while they work through problem sets assigned to them by their teachers, and teachers have access to real-time reports that enable them to personalize their lesson plans in order to address areas where their students struggle. ASSISTments enables teachers better to fit the learning needs of their students overall. In 2014, an average of 4,000 students used ASSISTments daily, and in 2013, 50,000 students made accounts (Heffernan, N. & Heffernan, C., 2014).

ASSISTments has a large impact on children's learning across the United States. This tool continues to assist teachers, students, and researchers to this day and is being constantly improved by the teachers, students, and researchers who helped build it to ensure it helps the users as much as possible.

Automatic Reassessment and Relearning

One aspect of ASSISTments that helps make the online learning tool so effective is the Automatic Reassessment and Relearning System (ARRS). ARRS is designed to help ensure students retain the skills they learn. By gradually reassessing students on topics they have mastered, students have a chance to really digest what they are learning. If they are unable to complete a reassessment on a topic, they then relearn the skill by completing new problem sets until mastery is once again achieved. A teacher has the option to use a default or custom number of reassessment levels in his or her ARRS settings to determine when a student no longer needs to be reassessed. The cycle of reassessment and relearning repeats until the final reassessment level has been completed, indicating the student has full, long-term mastery of the skill.

ARRS implements a spacing tool, which spaces out reassessments and relearnings in order to further increase students' retention. "The spacing effect occurs when we present learners with a concept to learn, wait some amount of time, and then present the same concept again" (Thalheimer, 2006). Spacing is proven to be beneficial



for remembering concepts in the long-term. When repetitions of skills are spaced out over time, students are able “to store information in memory in a manner that makes the information more resistant to forgetting than non-spaced repetitions” (Thalheimer, 2006).

The ability to retain the skills they learn over a longer period of time helps students perform better in the classroom and on standardized tests. When 97 eighth-grade students were analyzed to evaluate the effectiveness of ARRS, results showed that the students who had completed reassessments and relearnings for the math skills tested significantly better at the end of the year than those who had not (Soffer et al., 2014). The results of the research showed that “ARRS is an effective method for increasing student retention of critical knowledge and skills and in maintaining high levels of proficiency” (Soffer et al., 2014).

The other key component of ARRS within ASSISTments is the ability for teachers to see reports on the assignments that use ARRS. Different report views allow teachers to see how individual students are performing, whether students are completing their work on time, and how their class is understanding the curriculum as a whole. When

this kind of valuable information is displayed clearly for a teacher, he or she is better able to address the needs of his or her students, tailoring his or her lesson plans to go over concepts that seem to cause students to struggle as they work through their problem sets on ASSISTments.

Grade 7 2018-2019

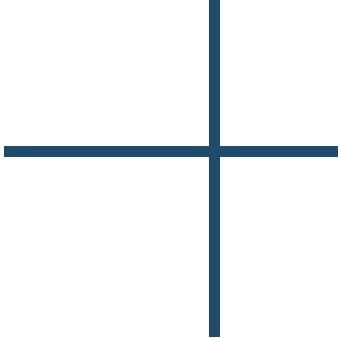
This class was archived on Aug 30, 2019

Reassessment Summary Report
 Reassessment Summary Report - Reassessment Skill Report
 Class: Grade 7 2018-2019

Students (79)	Daily Limit Exceeded	Late Total	Late Original Skill Builders	Late Reassessment Tests	Late Remediation Skill Builders
	0	28	26	1	1
	0	0	0	0	0
	0	20	0	0	20
	0	29	0	0	29
	0	10	2	3	5
	0	12	0	11	1
	0	22	1	12	9
	0	18	7	5	6
	1	13	7	0	6
	0	10	0	9	1
	0	15	4	1	10
	0	5	0	3	2
	2	22	6	1	15
	0	1	0	0	1
	0	13	0	13	0
	0	11	0	11	0
	0	0	0	0	0

Figure 1. ASSISTments 1.0 report page.

With Google Classroom becoming more prevalent throughout the United States, ASSISTments has undergone a transformation that now enables the use of their tool in coordination with Google Classroom. Teachers who already use Google Classroom for all of their classes can now incorporate ASSISTments much easier. While most of the original ASSISTments service has been transferred over to the 2.0 version, the



Automatic Reassessment and Relearning System has not yet been replicated in the new system. Many teachers who used ASSISTments 1.0 utilized ARRS and are now unable to because of the shift towards integration with Google Classroom.

The goal of our project was to create a minimum viable product of the Automatic Reassessment and Relearning System within ASSISTments 2.0 by implementing and combining key aspects from the existing 1.0 system with current needs of teachers and students.

ARRS MQP REPORT

DESIGN



DESIGN

This section covers the initial research and thought process behind the design of the minimum viable product for the ARRS implementation in ASSISTments 2.0.

Discovery

In order to build a product that best suited the needs of the user, our team dedicated time to understanding the ASSISTments system. We explored ASSISTments 1.0 and 2.0 from the perspective of a teacher user to understand how teachers used the existing Automatic Reassessment and Relearning System. Seeing real classes, students, assignments, and reports enabled us to finalize the ARRS 2.0 user requirements.

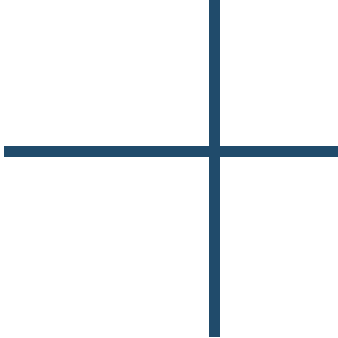
While ARRS existed fully in 1.0, only base code had been written in ASSISTments 2.0. As a team, we devoted many hours to reading and testing the existing ARRS code in order to build upon and expand its functionality. We were then able to divide the programming workload into three main sections while keeping in mind the need to link every new feature to the existing system.

Student Landing Page

Through our exploration of ASSISTments 2.0, it was discovered that students had no easy way of viewing assignments that used ARRS. ARRS could not be easily linked with Google Classroom, and as a result, students were unable to see new reassessments or relearning assignments. After discussions with our advisor and the Teacher Experience Team, we decided there was a need for a student landing page. A student would be directed to this landing page by clicking on an assignment in Google Classroom. This page would need to display all of the student's ARRS assignments and allow him or her to navigate to any specific homework problem.

Settings Page

Because ARRS relies on scheduled releases of reassessments related to initial assignments, teachers must have the ability to customize their schedule and choose when their students will be tested on a skill they have previously mastered, or if they will be tested at all. Teachers need a settings page to be able to enable ARRS and choose the number of days between reassessments. While the framework for this



functionality had been built in ASSISTments 2.0, it needed to more closely resemble ASSISTments 1.0, so it would better fit the needs of the teacher user.

Reports

ARRS reports are critical to the success of ARRS because they enable a teacher to view the progress of individual students and the class as a whole. The ARRS reports in ASSISTments 2.0 need to replicate the existing reports in 1.0 for a minimum viable product. These reports can be seen below in Figure 2, Figure 3, and Figure 4. There is a Student ARRS Report which displays the ARRS assignments and progress for a single student. The Reassessment Summary Report or Class Report shows a class broken down by each student and statistics on all of their reassessments in that specific class. The teacher can also see progress on individual ARRS assignments and the different reassessment levels reached.

ASSISTments Teacher Student Builder Account Mrs. Kelly (kln.kelly@leominster.net.edu) L292341

Home Classes Reports Grade 7 2018-2019 Messages Preferences Need help?

This class was archived on Aug 30, 2019

Student ARRS Report

Student: Madison Bashaw
Class: Grade 7 2018-2019

Legend:
 Student has not started this assignment.
 In progress. Meaning that Student has started this problem but still not finished.

Exceeded Daily Limit Skill Builders (Includes original and Remediation skill builders)

Assignments (0) Last worked on How many students in this class have exceeded the daily limit

Late Original Skill Builders

Assignments (7)	Due dates	Status
114 - Volume of Prisms 7.G.B.6 (Problem Set PSANJX)	2019-04-01 08:00:00	<input checked="" type="radio"/>
109 - Percent Increase or Decrease 7.RF.A.3 (Problem Set PSABKOR)	2019-03-25 08:00:00	<input type="radio"/>
76 - Finding the Missing Value using a Maps Scale 7.G.A.1 (Problem Set PSANFQ)	2019-02-11 08:00:00	<input type="radio"/>
79 - Using Scale Factor 7.G.A.1 (Problem Set PSAGRY)	2019-02-11 08:00:00	<input type="radio"/>
74 - Finding Scale Factor 7.G.A.1 (Problem Set PSADHIG)	2019-02-11 08:00:00	<input type="radio"/>
68 - Area of Circles from Images 7.G.B.4 EX (Problem Set PSAPBPW)	2019-01-28 08:00:00	<input type="radio"/>
56 - Combining Like Terms 7.EE.A.1 EX (Problem Set PSASFYS)	2018-12-10 08:00:00	<input checked="" type="radio"/>

Late Reassessment Tests

Assignments (9)	Due dates	Status
		<input type="radio"/>

Figure 2. ASSISTments 1.0 report view 1.

ARRS Progress Summary

Assignments	Original Skill Builder	Reassessment Test Progress	Next Test Release Date	Remediation Currently Assigned
15 - Adding Integers 7.NS.A.1d (Problem Set PSAHQ8)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	All reassessment tests completed	
16 - Subtracting Integers 7.NS.A.1d (Problem Set PSAHKL)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	All reassessment tests completed	
17 - Adding or Subtracting Integers 7.NS.A.1d EX (Problem Set PSAZKQB)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	All reassessment tests completed	
18 - Adding or Subtracting Negative Decimals 7.NS.A.1d (Problem Set PSAGGM)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	2019-08-01 06:00:00	
37 - Converting Fractions to Decimals 7.NS.A.2d (Problem Set PSAHRO)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2019-02-04 06:00:00	
49 - Solving 2-Step Equations 7.EE.B.4a EX (Problem Set PSAHQV)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2019-02-04 06:00:00	
61 - Solving Inequalities 7.EE.B.4b (Problem Set PSAQWXY)	<input checked="" type="radio"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2019-06-13 06:00:00	
10 - Adding and Subtracting Mixed Fractions 5.NF.A.1 Ex (Problem Set PSA7GUA)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	All reassessment tests completed	
9 - Ordering Rational Numbers 6.NS.C.7.A (Problem Set PSAGJ4)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	All reassessment tests completed	
20 - Order of Operations with exponents 7.NS.A.3 (Problem Set PSASH7U)	<input checked="" type="radio"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	All reassessment tests completed	
56 - Combining Like Terms 7.EE.A.1 EX (Problem Set PSASFYS)	<input checked="" type="radio"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2019-06-13 06:00:00	
74 - Finding Scale Factor 7.G.A.1 (Problem Set PSADHIG)	<input type="radio"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Skill builder not completed	
76 - Combining Like Terms 7.EE.A.1 EX (Problem Set PSASFYS)	<input type="radio"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Skill builder not completed	

Figure 3. ASSISTments 1.0 report view 2.

Grade 7 2018-2019

This class was archived on Aug 30, 2019

Reassessment Summary Report
 Reassessment Summary Report - Reassessment Skill Report
 Class: Grade 7 2018-2019

Students (79)	Daily Limit Exceeded	Late Total	Late Original Skill Builders	Late Reassessment Tests	Late Remediation Skill Builders
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	0	12	0	11	1
	0	22	1	12	9
	0	18	7	5	6
	1	13	7	0	6
	0	10	0	9	1
	0	15	4	1	10
	0	5	0	3	2
	2	22	6	1	15
	0	1	0	0	1
	0	13	0	13	0
	0	11	0	11	0
	0	0	0	0	0
	0	11	0	0	0

Windows taskbar: Type here to search, 2:59 PM 9/6/2019

Figure 4. ASSISTments 1.0 report view 3.

DEVELOPMENT

DEVELOPMENT

This section will discuss the features of the final minimum viable product for the student landing page, settings page, and reports pages.

Student Landing Page

The student landing page went through three iterations of design. The first design of the landing page used the concept of containers to divide a student's workload into four different sections: ARRS Assignments, Reassessments, Relearnings, and Non-ARRS.

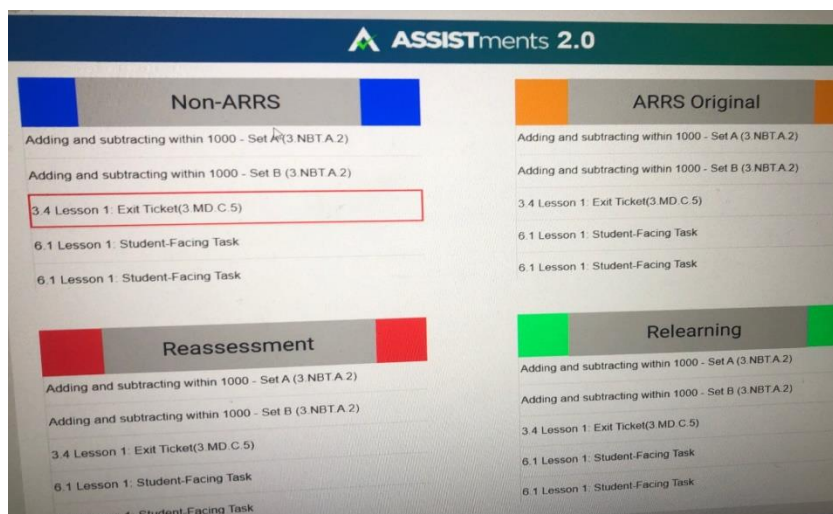


Figure 5. Student Landing Page Design 1.

The second iteration was completed for the first demo of the minimum viable product. After meeting with ASSISTments' Teacher Experience Team, we changed the design to fit their feedback about a cleaner, more simple design. This version of the landing page grouped assignments by ARRS assignments and regular assignments into two different stacked containers on one web page. The assignments were sorted by the most recently assigned and, once clicked, directed the student user to the actual problem set.

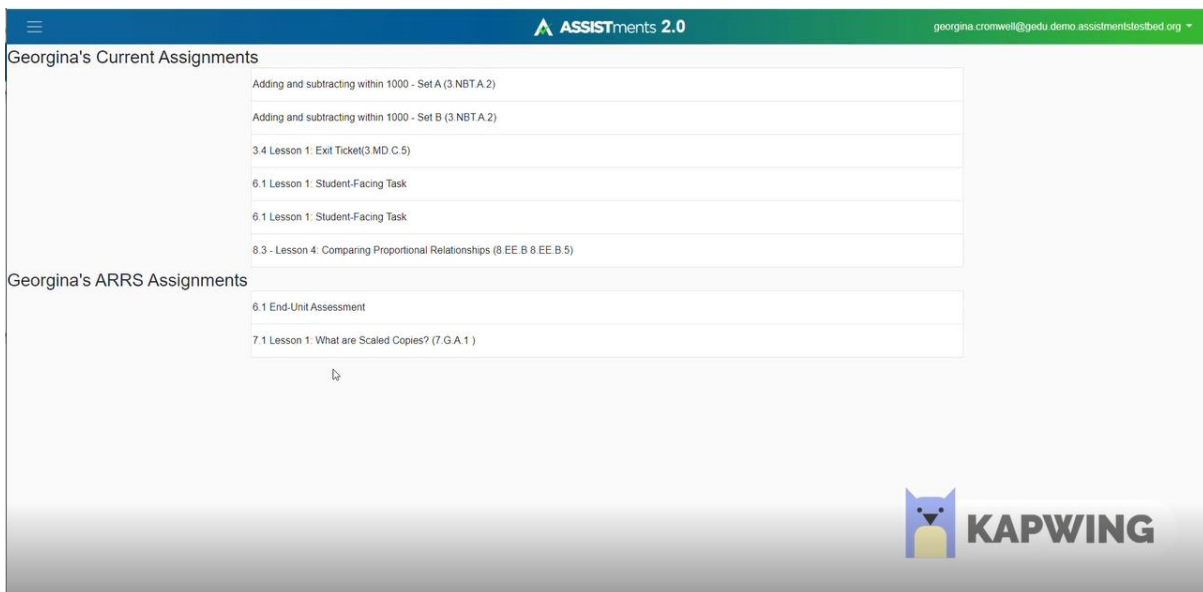


Figure 6. Student Landing Page Design 2.

After more conversations with the Teacher Experience Team and our advisor, we decided to implement a way for students to see their progress on ARRS assignments within the student landing page. We added a checkbox progression to display how

many reassessments a student has completed for an ARRS assignment

and an indicator of the release date for the next reassessment. If a

student fails a reassessment, the relearning assignment is shown as well.

STUDENT LANDING PAGE Georgina Cromwell					
This is the landing page for the assignment you selected					
Assignment	Current Assignment Type	Current Assignment Status	Due Date	Next Release Date	Reassessment Progress
Assignment 4	originalAssignment	○	2/22/20 5:20 PM	2/20/20 5:20 PM	□ □ □
Other Assignments					
Assignment	Current Assignment Type	Current Assignment Status	Due Date	Next Release Date	Reassessment Progress
Adding and subtracting within 1000 - Set B (3.NBTA.2)	notARRSAssignment	●	10/4/19 12:19 PM (LATE)		
3.4 Lesson 1: Exit Ticket(3 MD.C.5)	notARRSAssignment	●	10/4/19 1:37 PM (LATE)		
Adding and subtracting within 1000 - Set A (3.NBTA.2)	notARRSAssignment	○	10/12/19 3:15 PM (LATE)		
6.1 Lesson 1: Student-Facing Task	notARRSAssignment	●	10/19/19 1:59 PM (LATE)		
8.3 - Lesson 4: Comparing Proportional Relationships (8.EE.B.8.EE.B.5)	notARRSAssignment	○	11/30/19 1:03 PM (LATE)		
Learning ASSISTments Practice Set (dnc)	notARRSAssignment	○	2/21/20 12:30 PM		
Learning ASSISTments Practice Set	notARRSAssignment	○	2/22/20 4:31 PM		
Assignment 2	reassessmentAssignment	○	2/23/20 11:00 PM	2/21/20 3:00 PM	✓ □ □ □
Assignment 1	reassessmentAssignment	○	2/23/20 11:00 PM	2/21/20 3:00 PM	□ □ □
Assignment 3	reassessmentAssignment	○	2/23/20 11:00 PM	2/21/20 3:00 PM	✓ □ □ □

Figure 7. Student Landing Page Design 3.

Settings

To be able to access the ARRS settings from anywhere in the ASSISTments world, a link to the settings page was added in the drop-down menu of the header in the top right of every web page. ARRS settings are only applicable to teacher users, so the link only appears in the drop-down menu for authenticated teacher users. The link directs users to the ARRS Settings webpage, where the main functionality enables a teacher to

change or update his or her ARRS release schedules for a specific class.

Default settings are in place for teachers who enable ARRS for his or her

classes. Once changed, the settings are properly stored for the specific teacher and class, and the settings apply to all assignments assigned after the settings were saved.

A teacher's ARRS settings are always checked whenever a teacher begins to assign an assignment, so only teachers and classes that utilize ARRS have the option to assign an ARRS assignment. The ARRS check box that appears if a teacher has enabled ARRS is shown below in Figure 8.

← ASSISTments 2.0

Assign new Problem Set to test class

Assignment Name (Leaving this blank will use the problem set name)

Learning ASSISTments Practice Set #1

Release Date

02/19/2020 1:47 PM

Due Date

Enable ARRS

Assign

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contact@assistments.org | © 2020 ASSISTments

Figure 8. Assign Page with ARRS checkbox.

In addition to the existing ARRS Settings features in ASSISTments 1.0, a feature was added that controls whether students in a specific class use the new ASSISTments student landing page. When ARRS assignments are enabled, the student landing page is turned on, but if a teacher does not want to have ARRS assignments, he or she now has the option to still include a student landing page. Below is a screenshot of the ARRS settings page.

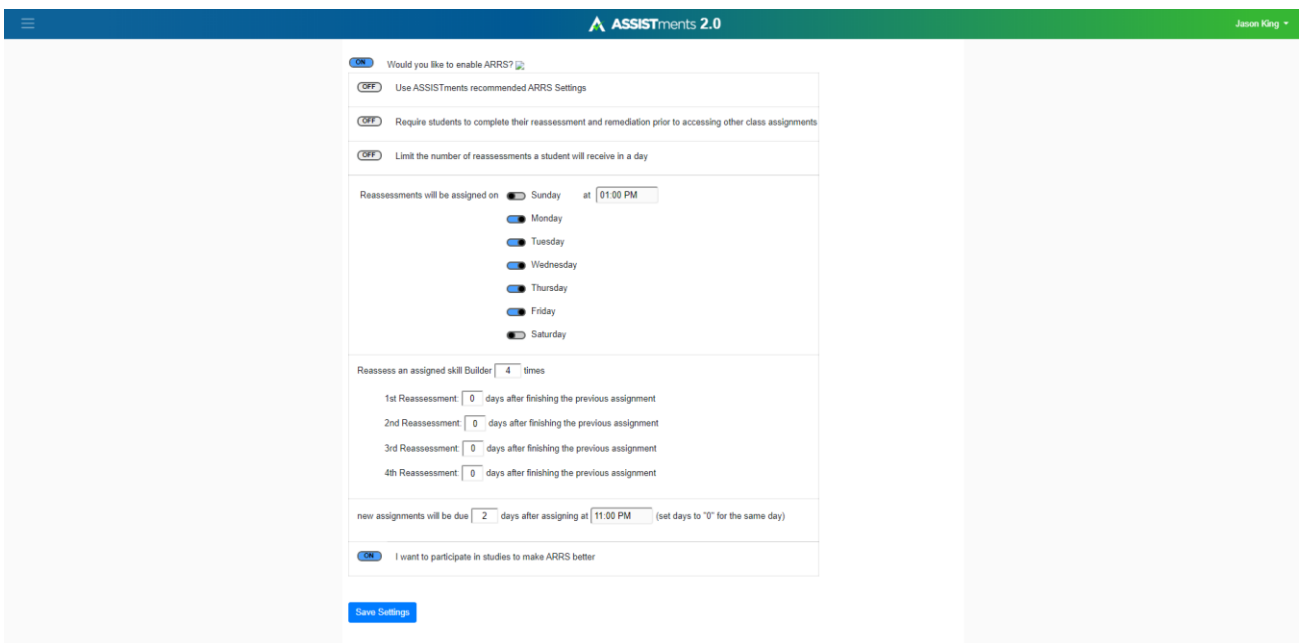
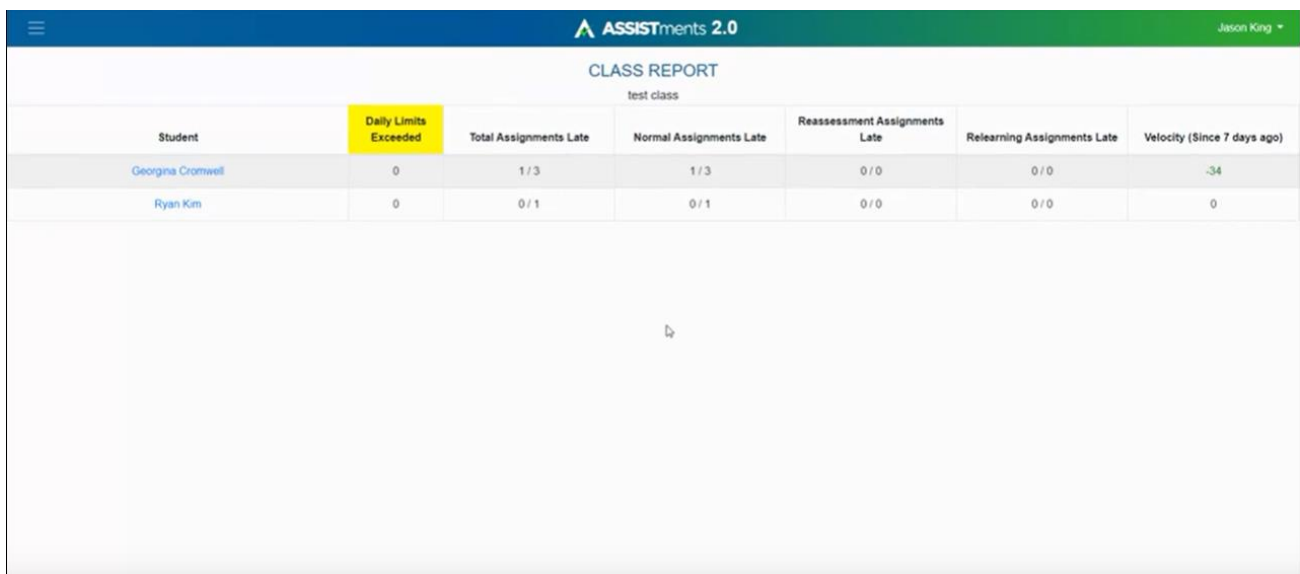


Figure 9. ARRS Settings Page.

Reports

Each ARRS report view that could be seen in ASSISTments 1.0 was recreated for ASSISTments 2.0. A teacher user can access these reports by clicking on one of their class's assignments in Google Classroom. The user is then directed to the class report for the assignment on which he or she clicked. This lists every student and corresponding statistics on their assignment progress. In addition to the existing ASSISTments 1.0 features, fraction denominators were included in the Total Assignments Late, Normal Assignments Late, Reassessment Assignments Late, and Relearning Assignments Late columns. A new velocity column was also added that gives the difference in late assignments between the current number and the number of late assignments recorded 7 days ago. This enables a teacher to see the progress made for each student.



Student	Daily Limits Exceeded	Total Assignments Late	Normal Assignments Late	Reassessment Assignments Late	Relearning Assignments Late	Velocity (Since 7 days ago)
Georgina Cromwell	0	1/3	1/3	0/0	0/0	-34
Ryan Kim	0	0/1	0/1	0/0	0/0	0

Figure 10. Class Report.

The student report is shown when a teacher clicks on a specific student's name in the Class Report. This takes the teacher to the Student ARRS Report, where he or she can see detailed information about a specific student's progress. Shown below is a bar graph which displays the student's number of late assignments each day, categorized by their assignment type. This gives teachers a visual representation of the progress being made on the student's late assignments.

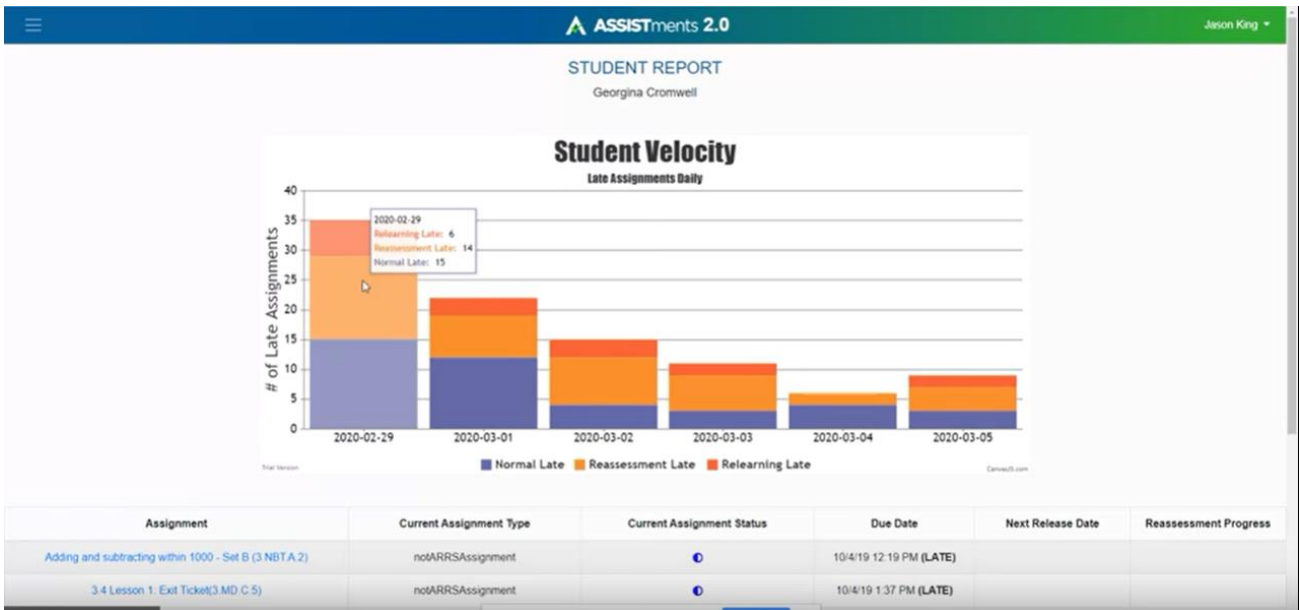


Figure 11. Student Report.

Underneath the graph, all assignments are ordered by due date and display the completed reassessment levels by check boxes similar to the check boxes on the student landing page. A checkbox contains a red 'x' if a reassessment level has been failed and a relearning assignment has been assigned, and the checkbox contains a green checkmark if the reassessment level has been completed. The status circle (blue circle) indicates the student's progress on each assignment, where an empty circle represents an assignment that has not been started, and a blue circle represents a complete assignment.

CONCLUSIONS & RECOMMENDATIONS

CONCLUSIONS & RECOMMENDATIONS

This section explains the user testing procedures and the feedback received from testing the minimum viable product with real teachers. Here we analyze the main conclusions deduced from the project and summarize our recommendations for future improvements to the system.

User Tests & Feedback

After the complete development of the initial minimum viable product, we tested the functionality and design of our web pages with teachers familiar with using ARRS in their classrooms to receive feedback. Screenshots of each webpage and the navigation flow were shown to the users, and questions were asked in order to encourage feedback. The list of questions posed to the teachers can be found in Appendix A.

Conclusions

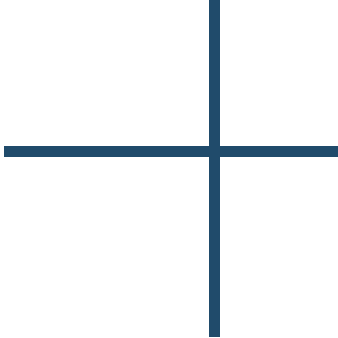
From the tests, we gathered that our minimum viable product would fit the needs of the teacher and student users. A few of the initial suggestions made by teachers were immediately implemented. The class report velocity column, color coding, and student report bar graph were added after interviewing teachers. Some of the language on the settings page was also changed to give better clarity. Other changes, improvements, and ideas that were suggested in the teacher interviews were analyzed and prioritized to be documented as future work.

Recommendations for Future Work

On top of the need to update the ARRS code to utilize the new ASSISTments SDK, we suggest other improvements to be made to the product to better fit the needs of the teacher and student users.

Repayment Plan

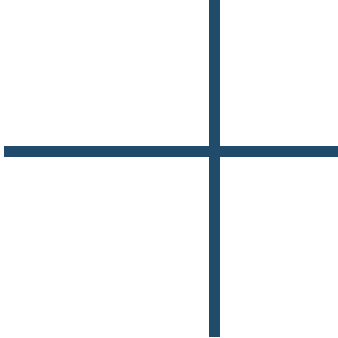
The idea of a "repayment plan" feature is something that was proposed to teachers during our interviews, but it was not implemented by our team. When a student gets



behind in work and late assignments start to build up, the student can get discouraged by the large amount of work to be done. Teachers could utilize a repayment plan, which would restrict an individual student from seeing and completing more than a configurable number of assignments per day or week. This feature would allow teachers to create a personalized plan to get a student back on track by giving him or her a specific, achievable goal without overwhelming them.

Vacation Pause

A feature was requested by one of our interviewed teachers that would allow a teacher to pause the release of reassessments while students are on vacation. This way, students would not be overwhelmed with assignments upon returning to school. Our team did not implement this feature as Jack Gonsalves has already implemented a similar feature in the actual assigning of reassessments and relearnings. Assignments will not be released to students if the student does not navigate to his or her landing page. Once a student loads the landing page, his or her assignments are released, and due dates are pushed back accordingly. This ensures a student will not be overwhelmed



by ARRS assignments. A more configurable vacation pause feature, such as vacation time, could be implemented in the future.

Reassessment Assignment Creation

Currently, reassessment assignments are generated by taking the problem set of the original assignment and assigning that as a reassessment. The desired reassessment assignment is a randomly selected problem from the original problem set. This cannot be created until the project is moved to version 3.0 of the ASSISTments sdk.

Limiting Reassessments

A setting should be implemented that would limit the number of reassessments a student will receive in a day. This setting should operate at a class level and is not yet implemented but would allow a teacher to have more control over his or her class schedule.

Requiring Students to Complete ARRS

A possible feature for the ARRS settings could restrict students from working on other assignments until their reassessments and relearnings were completed. This setting, also referred to as "strict mode," should operate at a class level and is not yet implemented.

Groupings

Grouping students by performance was a feature suggested by the Teacher Experience Team and piqued interest in one of the teachers that was interviewed. These groupings would divide students by how many late assignments they still need to complete. Such groupings would need to be configurable by the teacher in his or her ARRS settings, as different classes have different levels of intensity. This feature would allow teachers to quickly see the state of their entire class.

Class Navigation

Currently, a teacher views their class report and the students in that class by selecting an assignment in a specific class within Google classroom. Ultimately, the goal is to



instead enable the teacher to navigate to a class selection page from

anywhere in ASSISTments, similarly to how a link is offered for the ARRS

Settings. It was agreed that this was out of scope for our project, and thus was not implemented.

REFERENCES

REFERENCES

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APPENDICES

Appendix A – Teacher Interview Questions

Settings Page:

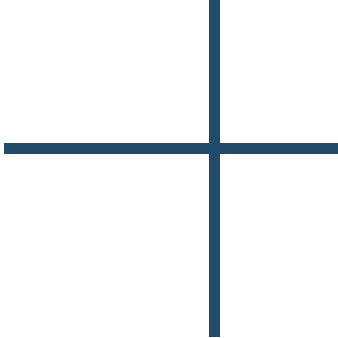
1. Can you describe how you would navigate to this page?
2. Can you explain how you would change your ARRS settings on this page?
3. What do you as a user expect to happen once you complete?
4. Is there any information you think is missing?
5. Is there any feature you wish you could control or personalize within the ARRS settings?
6. Do the current schedule options account for your needs as a teacher?

Student Landing Page:

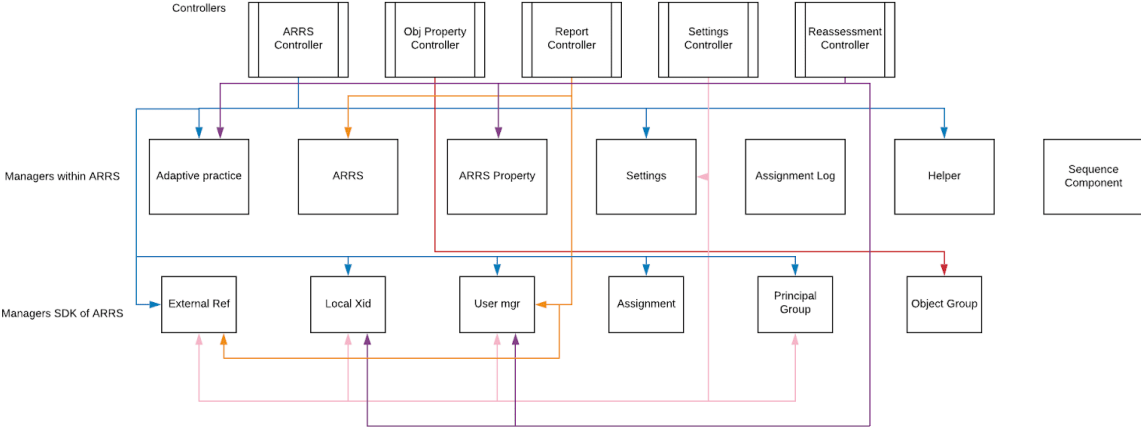
1. Do you believe all of this information is important to show the student?
2. Do you think your students would be able to navigate through their ARRS assignments using this web page?
3. What do you think about adding this landing page between the Google Classroom assignment and the actual problem set?
4. Do you think a student should be shown this page for whenever he or she clicks on any ASSISTments assignment? Or do you think they should only have to go to the landing page when they click on an assignment with ARRS?
5. What do you think about the idea of grouping students based on how many assignments they have late and unfinished?
6. Should we show that grouping indicator to the students? Or is the grouping something that only the teachers should see?

Reports:

1. (For each report): Is this the information you expect to see when you hear the name __name of report shown____?
2. Is there any information missing that you would like to see on this report?
3. Are there any other ways you would like to be able to summarize a class or student's ARRS work?

- 
4. What are your thoughts on seeing students progress over time in terms of late assignments left unfinished?
 5. What are your thoughts on displaying that information in a line graph over time for a whole class?
 6. What about displaying through a bar chart over time for a whole class?
 7. What are your thoughts about displaying an individual student's progress over time through a line graph or a bar graph?
 8. What are your thoughts on incorporating a summary pie chart that groups students based on how many (ARRS) assignments they have late and unfinished?
 9. How do you feel about linking reports by navigating to one specific in Google Classroom and being shown links to other reports?
 10. How do you feel about having a teacher landing page similar to the student landing page where you have access to your reports and assignments and classes?

Appendix B – ASSISTments Diagram



Appendix C – Interview 1

Teacher 1 (Male)

Questions:

1. *Assigning with ARRS*
 - a. *Check box--makes sense?*
2. Reports
 - a. *Are there any other reports you want to see for ARRS?*
 - b. *How would you feel about a graph or visual representation of your class?*
 - c. Colored groupings based on number of assignments late?
 - Column is enough for the teacher
 - But any quick visual to reduce the analyzation
 - Histogram would be useful yes/no

He really cares about the students he needs to spend extra time with, the graph would save time instead of writing names down--but not a make-or-break feature

He likes writing names down and allowing kids to scratch off their own name

- *Column showing "completed since teacher last viewed"*
 - He is essentially doing the same thing (paper pencil)
 - He has conversations with students --goes through and looks at all of their landing pages and keeps track on paper, but this column would make it easier to know before face-to-face conversation
 - (gives hw sometimes where they have to do ALL overdue things)
 - He likes the ability to control the number of assignments seen on the landing page

- Would be cool to individualize it per student--some kids like to see everything they have to do, some only want to see five assignments, some can only see two--wants to be able to control that
- Because skill builders can be simple or super tricky, the teacher would like the ability to pick and choose which assignments were visible for each student would be really nice, but not necessary
- Thinks the graph would be really helpful for students and parents especially during parent teacher conferences--visual representation would be great, could even print and have the student review it with their parent, easy to understand

3. Student Landing Page

1. *Anything your students might like/dislike about this?*

- In the 1.0, mirror as much as possible in 1.0
 - He likes the groupings better--reassessments, relearnings, and skill builders color coding
 - Reassessments should be priority number 1, shouldn't just be doing originals, so they build gradually
 - In 1.0 would have to go to reports to see progress bar of reassessments and assignments, likes seeing that on the landing page
- *Any information you don't want to show your students?*
 - *Download button use in ASSISTments 1.0?*
 - Students don't use it; online only

4. ARRS Settings

1. *How do you feel about the default scheduling?*

- Typically uses the default scheduling but there have been years where he has limited the number that they can see in a specific day
- Reassessment assignment time he uses the default
- Most of the settings he uses default
- Is there anything else you wish you could personalize?
 - Can't think of anything missing, mostly uses default
 - Likes the way it works currently
 - Individually per students showing assignments on the landing page
 - The vacation problem doesn't really affect him
 - He has them go online once every two weeks, and says everyone has to be on it for the next five minutes, will work on overdue stuff in class
 - He doesn't assign too many--bits and pieces, based on current chapter and topic
 - (ex. Just assigned 6 skill builders and two weeks to do it)
 - Then homework gives two nights to do overdue
 - He doesn't do more than 80 in a year, but if he assigned 4 per week then he could see the vacation problem

*General feedback:

- Skillbuilders is what got him into ASSISTments to begin with, ease of assigning and simplicity of program being automatic really sold him
- Then allowed him to be more interested in building his own content
- Would really love to see ARRS in 2.0, it is so important --this first official piece(ARRS) is what sold him on ASSISTments
- If there is any small group testing they need to have done please reach out to his class he would love to have his students help! Super excited

Appendix D – Interview 2

Teacher 2 (Female)

Comments on student perspective/in general:

- With 1.0 she's able to copy one classes assignments into a different class**wants this
- But google classroom doesn't enable duplication of class with all of assignments—so we have to do it or figure it out
- She has to go through each assignment and change each due date (even though there could be an option to change the years and the day by like 1 for every assignment)
- She was wondering if they could just get to landing page without going through landing page
- Made sure could do all assignments through the landing page, not having to go back and forth between google classroom to actually get to the tutor
- Jason made some comment about a teacher view that's similar to
- Complete assignment she wants moved to the bottom or done, grayed out
- I'm confused because I thought done assignments didn't show up so?
- She likes keeping the completed assignment on the landing page*
- She wants the students to be able to show her the problem again (if they had done something wrong)—they can do it now before they complete the thing
- She assigns on Fridays, Wednesdays goes on and sends reminder email

REPORT

- She runs the reassessment and remediation report (she doesn't really use the unfinished assignment report)

- She looks at total late column
- She's not strict about the reassessment dates
- Then looks at the original skill builders to see what originals or late (if not originals then maybe they didn't realize they were assigned)
- She emails them if they are too behind (wants an email feature if more than five late)
- She likes the idea of the visual groupings
- When she clicks the late column it doesn't really sort it (wants the ability to sort by late assignments)
- When looking at progress, she remembers and then can talk to them
- She likes Jason's graph
- Wants reassessment and originals separate though because reassessments can sneak up
- Neils column about since last Friday they have done this
- Could be sorted by this
- With some heavy hitters she does click on their individual name to see what's going on with them
- This tends to be a little slow when she clicks on the student name (she takes a screenshot to send to student and parent then)
- She likes the idea of a repayment plan: wants to change deadlines for a particular student—so a kid can feel some success
- Shift and stagger the due dates for the set of assignments for this student
- But vicious cycle—keep current as is, and then only the late ones on the repayment plan (so don't push new assignments that are released for the student/class)
- And then can she modify the repayment plan (okay five was too many, bring it down to three)
- She would group reassessments and relearnings together *no repayment plan for originals
- Most students do the original assignments
- She would love to send a great positive email not just negative emails
- Column added to main report would be great and easier to see

- Some parents are hooked up (likes the idea of streaks—did a bunch of assignments so that way the parents and teacher could see progress)
- An email from ASSISTments doesn't go to the students would have to talk to IT to allow emails from them to go through---automated messages idea *automation would be a great idea
- List of parents in recipients on names for sending a message for 1.0 is alphabetical by first name (wants last name)—students was by last name
- She likes column default of since the teacher last saw the page date (progress since)
- Likes to see groupings on the student report—not just one flowing list

ARRS SETTINGS

- Brand new teacher would be overwhelmed by ARRS settings (maybe keep in background)
- She just uses defaults (and she is a "power user")
- Only thing she would really like is to "Pause" during vacations, threshold she really didn't care about but we will really need to do it there
- Could predict Christmas break and stuff as well as thanksgiving
- Played with feature make sure they do everything first but disaster because kids who had 43 due could never do anything so she can't use the feature
- Suggested some sort of repayment plan solution, or have to do last night's homework before tonight's homework (could implement it so if only had one thing overdue have to last nights hw first before today's new one)
- She says if they have one late—she is not concerned at all

GENERAL NOTES

- Likes how you get three tries and get them good its all good,
- Doesn't like if you hit a negative accidentally it's done and it's wrong (wants a second chance feature)
- Group assignments together
- Sometimes are still there, don't properly save that he does it

- Has to go on and click it again (remediations and reassessments)
- Remediations pop up a bunch and its annoying cause you think you're done
- 3 do all five all at once
- ****Last week on school vacation, can't hit pause on reassessments***
don't assign during these dates
- Sometimes get notifications that they run out of space and you have to press okay it's from ASSISTments
- Her settings are on for allowing to download and do them offline, but it's not allowed for her students, but download button did show—so they can hit download button, but fail to download after hitting it (screenshot)
- Most not using download feature
- "there is an app but it doesn't work—when talking about doing assignments offline"
- They liked how we have it one list for student landing page (not separated by reassessments, relearnings, or remediations)
- Change the color for the type of assignment
- One suggested abbreviations for the types of assignments
- Likes not going through all the folders on the page (sometimes they accidentally close the folders on 1.0)
- One likes the visual checkmarks on the boxes for reassessments and the x's
- Right now they don't know
- Like knowing when the release date because in 1.0 it's a surprise
- Like a notification that they have reassessments released
- Pops up when you have a certain amount of reassessments or assignments (teacher doesn't want to have students feel anxious about having to constantly check to see if they have reassessments—she is learn

Appendix E – Files Changed

Student Landing Page & Reports

Below are the names of the repositories and files that were changed and added for the implementation of the student landing page.

ARRSService

AdaptivePracticeManagerImpl.java

- Created checkIfFinished() as a temporary function to check if any assignments have been completed by a student. This will be run on the student landing page until events have been implemented
- Changed checkForRelease() to try to get it to work as intended, but ultimately it is not used anymore

ARRSManagerImpl.java

- Changed processFinishedReassessment() to correctly modify the StudentARRSRecord when the reassessment is passed/not passed. The record is now archived if the last level of reassessment is completed
- Changed createReassessmentAssignment() to update the StudentARRSRecord with new dates and tracked assignment id. Additionally, change the function to set the release date of new reassessments to the current time if in debugging mode, and to give the reassessment the same name as the original
- Changed createRelearningAssignment() to update the StudentARRSRecord with new dates and tracked assignment id

HelperManagerImpl.java

- Changed findOriginalAssignment() to find the original assignment using the AssignmentManager as opposed to the trackerDao (which is not implemented)

ARRSTableType.java

- Added some lines to create StudentSnapshot/DailyLimit database tables

ARRSService (new files)

StudentSnapshotDao.java, JbdcStudentSnapshotDao.java, StudentSnapshot.java

- Files generated to create StudentSnapshot (late assignments by student by teacher) table in database

DailyLimitDao.java, JbdcDailyLimitDao.java, DailyLimit.java

- Files generated to create DailyLimit (assignment attempts per student) table in database
- These files are not currently in use, as the setting has not been implemented

TNG

assign2.jsp

- Added ARRS checkbox and link to settings page when Teacher does not have ARRS enabled

AssignFormData.java

- Changed to keep track of class external references and whether or not the teacher has enabled ARRS

XisManagerTngImpl.java

- Changed to return UCB's that navigate the student to the Student Landing Page, and the Teacher to their Class Summary Report (temporary until class selection is implemented)

TNG (new files)

landingPage.jsp

- Student Landing page where a student can view all of their released assignments

ARRSLandingController.java

- Controller for displaying the student landing page

studentSummaryReport.jsp

- Student Report where a teacher can view a student's current assignments, and their lateness over time

teacherSummaryReport.jsp

- Teacher Class Report which shows each students' current number of late assignments, and their velocity since seven days ago

assignmentReports.tag

- Standard format for displaying a list of AssignmentRows in a table

StudentARRSReport.java

- Domain object that contains all information necessary to display an individual student's late status to a teacher

StudentAssignmentReport.java

- Domain object that contains all information necessary to display both a notARRS and ARRS assignment to a user

ReportManagerARRSImpl.java

- Contains functions for retrieving studentARRSReports and StudentAssignmentReports

TeacherSummaryReportController.java

- Controller for displaying both Teacher report pages

SnapshotManagerImpl.java

- Contains the functions necessary for the nightly insertion of StudentSnapshots, and the retrieval of one or more StudentSnapshots

ARRSReportController.java, ARRSReportLateController.java,

ARRSReportStudentController.java, ARRSReportSummaryController.java

- First attempt at creating ARRS reports. These files are unused and can be removed if deemed unnecessary

reportIndividual.jsp, reportLate.jsp, reportSummary.jsp

- First attempt at creating ARRS reports. These files are unused and can be removed if deemed unnecessary

ARRS Settings

Below are the names of the repositories and files that were changed and added for the implementation of the student landing page.

TNG

functions.tld

- Added ability to use the method `getSettingsUrl()` in the navbar.

navbar.tag

- Added method to create the settings URL, and some logic for when the settings page should be shown as an option to the user.

NavbarHelper.java

- Uses LoginPortalUrlsCopy currently instead of the original file, as could not change the original file. Can also use original file and add the code added to a different file and import that, but other navbar functionality was already in the other file.

ARRSLandingController.java & AssignController.java

- Changed logic based on settings information to accurately choose when to display certain pages.

LoginPortalsUrlCopy

- Literal copy of the LoginPortalsUrl.java file which is inaccessible by us. Only added navbar URL functions.

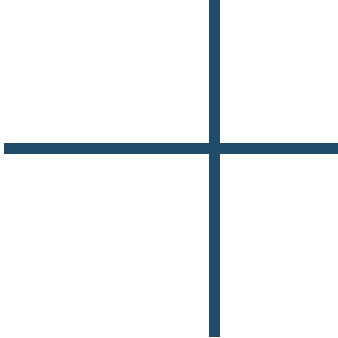
ARRSService

arrsSettings.js

- Added functions to use in the arrsSettings.jsp page. Mainly for onoffswitch and display/value manipulation functionality. As of current there is still the issue where the jsp page does not change the enable arrs switch value to off when the landing page is turned off. The value is correctly changed but the visual is not correct. Also other ways to go about implementing it if this is actually not what is desired.

arrsSettings.jsp

- Added in the new functions/methods created before. Rearranged divs to be more intuitive.
- Settings form updated to have enums relating to enabling the settings and enabling the landing page.
- Added enabling ARRS and enabling landing page functionality alongside on/off switches for each. Show or hide information based on the status of these switches. For the future could also have the arrsSettings features hidden and defaults turned on (similar to how it works in 1.0 and based off



of the teacher's feedback), and also the arrsSettings page will be navigated to through an actual settings page which does not currently exist.

ARRSSettingsController.java

- Added functionality for the new enums (arrs and landing page), created the logic behind creating and calling to the settings page URL (can be changed, currently works based on the xref given. If it the teacher account xref -> teacher settings, class xref -> class settings. No way to actually navigate to the class/more specific settings for our project).
- Changed logic for pulling settings, getting default settings, and saving settings from the jsp page form.