Requirements Analysis

Smarter Balanced Assessment Consortium Test Delivery System

Component: Administration and Registration Tools

Purpose: Smarter Balanced Task Order 10, Flexible Accommodations and Designated Supports

Delivered by: American institutes for Research

Delivered to: Smarter Balanced

Revision History

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| --- | --- | --- |
| **Revision Description** |  | **Date** |
| First Draft | David Lopez de Quintana | June 22, 2015 |
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# Task Description

This section describes why this feature is required and how the requirement will be met from a user’s perspective.

## What Is This Feature For?

The Smarter Balanced Usability, Accessibility, and Accommodations Guidelines describe a set of accessibility resources that are to be made available to students. These accessibility resources vary by subject area and sometimes grade. For example:

* Closed Captioning is only available for ELA and not Math
* The label for print on demand of stimuli for Math is “Stimuli” and for ELA it is “PT Stimuli and CAT Reading Passages”
* Only the English glossary is available for ELA while glossaries for many languages are available for Math
* Math Grade 3 is not allowed “Calculator” and “Multiplication Table” as Non-Embedded Accommodations while grade 4-5 Math may have “Multiplication Table” and Grade 6-11 Math is allowed both

These usability features are also subject to change over time. Changes were recently approved to the UAAG guidelines. For example, “Read Aloud Spanish Stacked Translations” is now available as a non-embedded designated support for Math.

These accessibility features are assigned to a student in the Create/Modify Student page in the Administration and Registration Tools (ART) system. However, ART has the following limitations:

* The set of available accessibility resources offered by ART does not vary according to subject area or grade; they are a fixed superset of accessibility resource that may or may not apply to certain subject area or grades
* Changing the set of accessibility resources offered by ART requires changing the ART system code

Task Order 10 seeks to address these limitations in the following ways:

* ART is to be modified to read an external configuration file that contains instructions on what accessibility resources to offer
* ART will be modified to offer different accessibility resources and resource labels based on the subject area selected and the student’s enrolled grade when it is appropriate to do so
* ART will be modified to validate the Designated Supports and Accommodations file upload against the currently configured set of accessibility resources

The Reporting system will be able to use the configuration file to configure its accessibility resources as well. However, this work is beyond the scope of Task Order 10.

## How Will This Feature Affect the User?

The following screen capture shows various elements of the ART create/Modify Student Page. This page is used to create a new student or to modify a selected student via the user interface. Most of the page is for filling out the student’s demographics. The red rectangle at the bottom shows the Designated Supports and Accommodations selections. For simplicity, we will refer to this as “accessibility resources” for the remainder of this document.

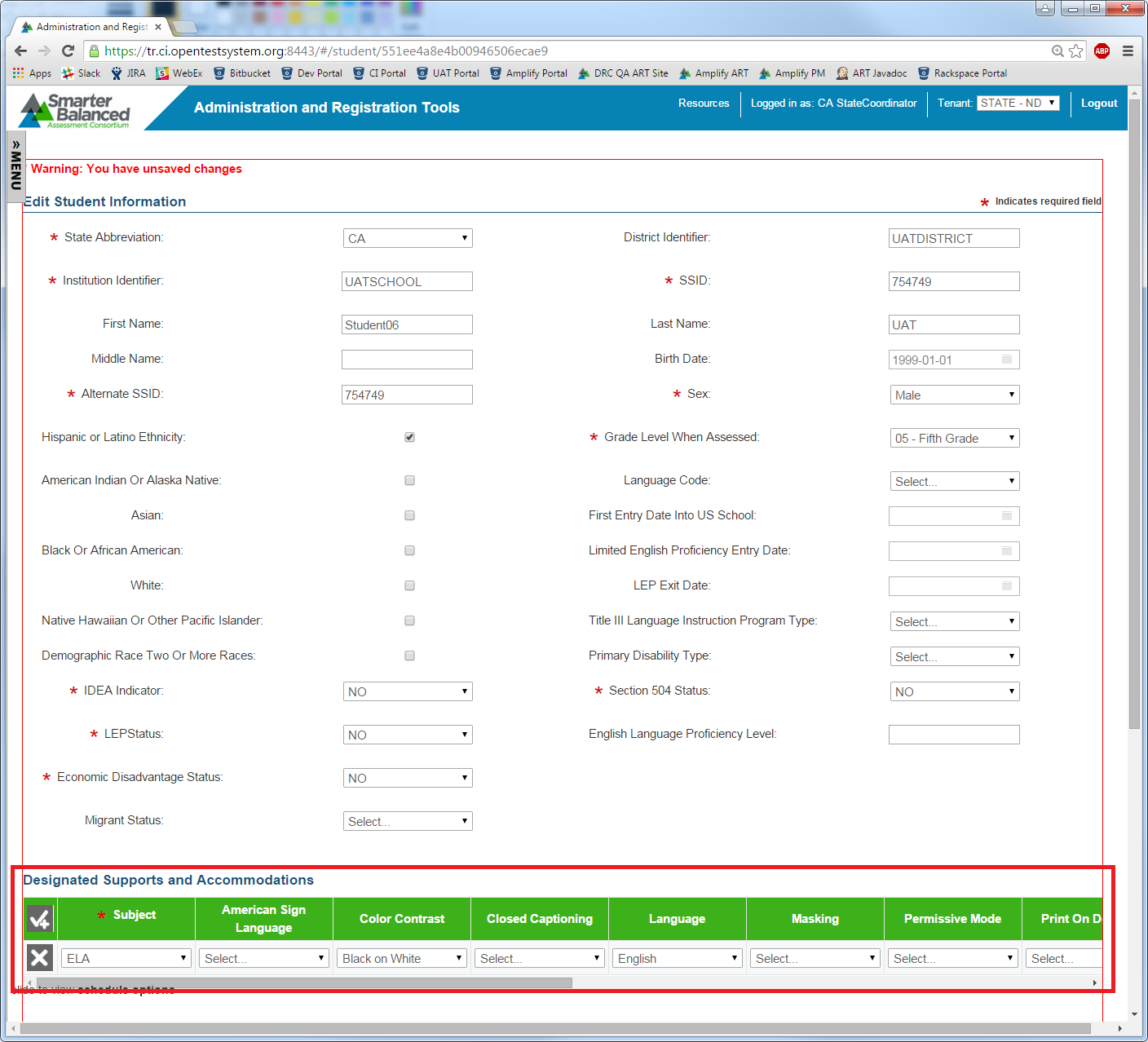


Figure . ART Create/Modify Student Page

One set of accessibility resources in ART can be created for each subject area. Task Order 10 seeks to make accessibility resources dependent on the selected subject and the grade level when assessed.

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Figure . Subject Area and Grade Selections

The following shows how the resource selections can vary according to subject area. The selections for the Print on Demand accessibility resource on the left are appropriate for Math while the selections on the right are appropriate for ELA.

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| --- | --- |
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Figure . Print On Demand Options for MATH (left) and ELA (right)

Please note that the heading titles cannot vary according to content area and grade level. This is necessary to preserve the tabular format of the page that presents a common heading regardless of subject area or grade. This has implications for resources like Closed Captioning that are only available for ELA and not Math.

The Closed Captioning resource must exist for both subject areas to preserve the tabular presentation format, but Math can be configured to disallow any selection. The following shows how this feature is used to disallow selection of the Closed Captioning dropdown for Math but allows for selection for ELA.

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| --- | --- |
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Figure . Disallowed Selections for MATH (left) But Allowed for ELA (right)

## How Is This Feature Configured?

An XML configuration file is created by an administrative user to configure this feature. The configuration file employs the following concepts and rules.

1. A Resource Family provides a container for accessibility resources.
2. A Master Resource Family provides the superset of accessibility resources and selections available to all resource families.
3. Resources in the Master Resource Family define the following:
   1. Resource type
   2. Resource code
   3. Left-to-right order
   4. Default selection (if desired)
   5. Heading text in any language (English required)
   6. Selections including:
      1. Selection code
      2. Selection order
      3. Selection labels in any language (English required)
      4. Selection message in any language (English required)
4. Resource families can be created for specific subjects and grades to override the default behavior of the resources defined in the Master Resource Family.

The following applies to the Master Resource Family and to Resource Families

* The Master Resource Family defines resource code, order, type, default selection (if any) and the heading label
* The Master Resource Family defines resource selections, selection code, selection order and selection label
* A Resource Family must declare the subject and grade(s) that apply
* If a resource is not declared in a Resource Family, then the Resource Family inherits all of the declarations and behavior of the resource in the Master Resource Family
* If a resource is declared in a Resource Family, then:
  + The following cannot be overridden: resource code, order, type, selection code, selection order
  + The following can be overridden: resource default selection, resource selection labels
  + The following can be omitted: specific resource selections, rendering the selection unavailable for a resource family
* The information in the Master Resource Family will be used for any subject/grade combination that is not overridden in a Resource Family
* The loading of the configuration file will fail if more than one Resource Family declares the same subject/grade combination

## How Will This Feature Be Implemented?

1. The ART Configuration XML file is crafted.
2. The XML file is read and validated against the XSD and the business rules above.
3. The validated XML file is transformed to JSON and inserted into the ART Mongo database.
4. ART will read the configuration information upon startup and modify its behavior accordingly.

# Task Order 10 Requirements

Task Order 10 Section 4 Description of Services states:

Contractor shall:

1. Write a specification for a configuration file (XML or JSON) that defines the following information about Accessibility Resources (Universal Tools, Designated Supports, and Accommodations)
   1. Accessibility Resource Name (e.g. Color Contrast)
   2. Accessibility Resource Description
   3. Accessibility Resource ID
   4. Codes for each possible setting for each resource
   5. Name and description corresponding to each code
   6. Default code/setting for each resource
   7. Translations of Resource Names, Resource Descriptions, Code Names, and Code Descriptions into multiple languages.
2. Build a configuration file that includes all resources used in the 2014-2015 Smarter Balanced tests with English-language Names and Descriptions.
3. Add the following student-registration enhancements to Administration and Registration Tools Java-based Component:
   1. Draw accessibility resource codes, names, and descriptions from a configuration file.
   2. Allow different accessibility resources to be designated as available for each test. In design consultation with Smarter Balanced, decide how sets of accessibility resources may be defined and how sets may be conveniently assigned to a test. (E.g. The available resource IDs may be included in the Test Registration Package).
   3. Update specifications according to the design in part b.
4. Test and deliver to Open Source Repository

The following table analyzes the requirements and provides a description of the technical approach towards addressing the requirement.

| **Requirement** | **Technical Approach** |
| --- | --- |
| 1. Write a specification for a configuration file (XML or JSON) that defines the following information about Accessibility Resources (Universal Tools, Designated Supports, and Accommodations) | XML is selected as the configuration file format because its schema can be documented in an XSD and validated against an XSD at runtime. |
| * 1. Accessibility Resource Name (e.g. Color Contrast) | A *label* element will be provided in the configuration file that describes the resource and is displayed in the user interface and used to validate upload file. |
| * 1. Accessibility Resource Description | A *description* element will be provided in the configuration file. |
| * 1. Accessibility Resource ID | A *code* element will be provided in the configuration file that provides a constant value and uniquely identifies the resource to TDS and to the Reporting system. |
| * 1. Codes for each possible setting for each resource | Each resource will contain *selection* elements that contain the following elements:   * A *code* element to uniquely identify the selection to TDS and Reporting * A *label* element to provide human-readable selection text * A *description* element to capture the description of the selection * A *message* element to provide additional information about the selection such as the appropriateness of the selection for certain tests |
| * 1. Name and description corresponding to each code | Provided in 1d |
| * 1. Default code/setting for each resource | Each resource will contain a *default* element that identifies the default selection if any. |
| * 1. Translations of Resource Names, Resource Descriptions, Code Names, and Code Descriptions into multiple languages. | Each resource will contain a *translations* element that in turn contains one or more *translation* elements, one for each transaltion. Each resource *translation* elements contains:   * A *language* element that contains the ISO 639-2 code that corresponds to the language translation * A *label* element that contains the translated resource label * A *description* element that contains the translated resource description   In addition to the resource translations, every selection element may also contain a translation element that contains one or more translation element, one for each translation. Each selection translation element contains:   * A *language, label and description* element provide the same function to the resource selection * A *message* element that contains the translated selection message |
| 1. Build a configuration file that includes all resources used in the 2014-2015 Smarter Balanced tests with English-language Names and Descriptions. | A Smarter Balanced-compliant configuration file with English names and descriptions is provided with this document. The configuration file captures the changes approved to the UAAG guidelines on June 2015. |
| 1. Add the following student-registration enhancements to Administration and Registration Tools Java-based Component: | ART will be modified to support the accessibility resource configuration file. |
| * 1. Draw accessibility resource codes, names, and descriptions from a configuration file. | ART will read the configuration file upon startup and store the configuration values. If the configuration file is not present when ART initializes, it will use the last stored configuration information. If this information is not available in the database and no configuration file is present, ART will not allow assignment of accessibility resources to students. |
| * 1. Allow different accessibility resources to be designated as available for each test. In design consultation with Smarter Balanced, decide how sets of accessibility resources may be defined and how sets may be conveniently assigned to a test. (E.g. The available resource IDs may be included in the Test Registration Package). | Test-specific assignment of accessibility resources will not be supported for the following reasons:   * ART does not require that all tests be fully loaded into the system before accessibility resources are assigned and may not be aware of particular tests at the time of accessibility resource assignment * Even if ART is fully loaded with all tests, it is impractical to assign a set of accessibility resources for each test   For these reasons, Smarter Balanced decided that instead of assigning accessibility resources separately on a per-test basis, ART would permit sets of accessibility resources to be defined according to subject area and the student’s enrolled grade.  ART does not currently customize accessibility resources and selection by subject area and grade, so this represents a significant step forward in customizability and configurability. However, even with resources configurable by subject and grade, some selections may not be appropriate to a certain test. For this reason, a translatable *message* element will be provided for each resource selection that gives the user additional information about the ramifications of the particular resource selection.  Smarter Balanced and AIR have deemed providing this information to be a reasonable substitute for configuring accessibility resources on a per-test basis. |
| * 1. Update specifications according to the design in part b. | This document and the attached artifacts define the specification of the configuration file as delivered. |
| 1. Test and deliver to Open Source Repository | This document and other requirements and design artifacts will be added to the ART open source repository. |

Table . Analysis of Task Order 10 Requirements

The technical approaches above address all of the Task Order 10 requirements but do not enumerate all of the features the configuration file needs to satisfy all of the needs of ART and the Reporting system. The following table below describes all of the elements of the configuration file and how they are used by ART.

| **XML Element** | **Cardinality** | **Allowable Values** | **Description** |
| --- | --- | --- | --- |
| Accessibility | 1 | N/A | This is the containing element for the configuration file. |
| Accessibility/MasterResourceFamily | 1 | N/A | A Master Resource Family is a containing element for an ordered list of resources. A master list is required to maintain tabular consistency between resource families in the ART user interface and in the ART file upload format.  For example, a resource not required in a Resource Family for a specific subject/grade combination but defined in the Master Resource Family will be included for consistency. The best that a Resource Family can do is present the resource but remove all available options so no selection is possible. |
| Accessibility/MasterResourceFamily/Resource | 1 or more | N/A | At least one Resource is required. |
| Accessibility/MasterResourceFamily/Resource/Code | 1 | String | Every resource must be referred to by a unique code. The resource code is defined here in the Master Resource Family and cannot be overridden in Resource Families. The code represents a contract between ART, TDS and the Reporting System to identify the same resource. |
| Accessibility/MasterResourceFamily/Resource/Order | 1 | Positive integer | The order of the resource must be defined and determines the order of presentation from left to right of the resource in the ART user interface and upload file. The value can be any positive integer and does not have to be increment by one from a previous resource, but no other resource may have the same value. For example, a Master Resource Family with four resources may have Order values of 10, 100, 300 and 1000 are acceptable and clearly denote the sequence of presentation of the resources.  The resource order must be defined in the Master Resource Family and cannot be changed by a Resource Family. |
| Accessibility/MasterResourceFamily/Resource/Type | 1 | SingleSelect, MultiSelect, Input | The resource type indicates whether this resource allows only one selection, multiple selections or is a simple input field. |
| Accessibility/MasterResourceFamily/Resource/DefaultSelection | 0 or 1 | String equal to one of the Resource Selection codes | A default resource may be optionally defined for the resource. It is not necessary for there to be an assigned default resource. If one is defined, the user interface will pre-select the resource with the default value. |
| Accessibility/MasterResourceFamily/Resource/Text | 1 or more | N/A | A container element for strings used for display purposes in the user interface or validation purposes in the upload file |
| Accessibility/MasterResourceFamily/Resource/Text/Language | 1 | Valid ISO 639-2 language code | The Language element indicates the language of this translation. At least one English (language=eng is required. |
| Accessibility/MasterResourceFamily/Resource/Text/Label | 1 | String | Every resource requires a label that determines what is displayed above the resource in the ART user interface or the column heading in the ART upload file. The label should reflect the indicated language. |
| Accessibility/MasterResourceFamily/Resource/Text/Description | 0 or 1 | String | An optional description of the resource can be provided. ART does not use this field. The label should reflect the indicated language. |
| Accessibility/MasterResourceFamily/Resource/Selection | 0 or more | N/A | The Selection element defines one of the possible values that may be selected for the resource. If a resource is type = SingleSelect, only one selection may be made for the resource. A type = MultiSelect resource allows the selection of one or more selections. |
| Accessibility/MasterResourceFamily/Resource/Selection/Code | 1 | String | Every selection must be referred to by a unique code. The selection code is defined here in the Master Resource Family and cannot be overridden in Resource Families. The code represents a contract between ART, TDS and the Reporting System to identify the same resource selection. |
| Accessibility/MasterResourceFamily/Resource/ Selection/Order | 1 | Positive integer | The order of the resource selection within the resource determines the order of presentation of drop-down single or multi-select elements. The order can only be defined in the Master Resource Family and cannot be overridden in a Resource Family. Resource Families may only select or omit resource selections as appropriate for the resource family. |
| Accessibility/MasterResourceFamily/Resource/ Selection/Text | 1 or more |  | This is the container element for resource strings that are displayed in the user interface and validated in the file upload. |
| Accessibility/MasterResourceFamily/Resource/Selection/Text/Label | 1 | String | A label is required for that indicates the resource selection in the user interface. This is the human-readable version of the resource selection code. At least one Text with Language=”eng” is required. |
| Accessibility/MasterResourceFamily/Resource/Selection/Text/Description | 0 or 1 | String | An optional resource selection description can be provided. |
| Accessibility/MasterResourceFamily/Resource/Selection/Text/Message | 0 or 1 | String | An optional user message can be provided that is displayed when the user makes this selection in the user interface. |
|  |  |  |  |
| Accessibility/ResourceFamily | 0 or more | N/A | This is the containing element for a resource family. If no resource family is defined in the configuration file, ART will use the resources and resource selections in the Master Resource Family for all subjects and student enrolled grades.  Resource Families inherit all the attributes defined in the master resource family. One is able to override some definitions in the master resource family, but anything defined in the master resource family that is not overridden in the resource family is automatically inherited in full by the resource family. |
| Accessibility/ResourceFamily/Subject | 1 | N/A | Subject is the containing node for information that describes for which subject this resource family is intended. |
| Accessibility/ResourceFamily/Subject/Code | 1 | String | The subject code (e.g. ELA) must be one of the configured ART subject codes. |
| Accessibility/ResourceFamily/Subject/Name | 1 | String | This is the full name of the subject (e.g. English Language Arts). |
| Accessibility/ResourceFamily/Grade | 1 or more | IT, PR, PK, TK, KG, 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, PS, UG | This resource family must apply to at least one grade and may apply to any number of grades. |
| Accessibility/ResourceFamily/Resource | 1 or more | N/A | If a resource family is defined, it must contain at least one overridden resource. Please note that the order or type elements cannot be overridden. A resource must be in the same location and of the same type as the master resource. |
| Accessibility/ResourceFamily/Resource/Code | 1 | String equal to one of the master resource codes | A code from a resource in the master resource family is only duplicated in a resource family so that some element of the resource can be modified for this resource family. That may be a resource label or translation. Resource selections may be omitted but no new resource selections can be added that do not already appear in the master resource family. Resource selection labels, defaults and translations can also be overridden. The resource code, |
| Accessibility/ResourceFamily/Resource/DefaultSelection | 0 or 1 | String | The resource default selection may be overridden or left as defined by the resource in the master resource family (even if the master resource family defines no default selection). |
| Accessibility/ResourceFamily/Resource/Selection | 0 or more | N/A | A resource selected for override in a resource family may have no selections, some selections or all of the selections defined in the master resource family.  No selections: If a resource is selected for override in a resource family but no selections are defined in the resource family, then the resource will appear for the resource family but no selections can be made. This is how an entire resource can be “deleted” from a resource family while keeping the place for the resource as defined in the master resource family.  Some selections: omitting one or more of selections for a resource deletes the omitted selections and includes the defined selections. Elements of the included selection(s) can be overridden.  All selections: this option would not omit any selection from the master resource but may override some aspects of the selections such as labels and translations. |
| Accessibility/ResourceFamily/Resource/Selection/Code | 1 | String equal to one of the master resource selection codes | Having a selection element with a code equal to one of the resource selection codes defined in the master resource causes the selection to be included. If a resource selection is defined in the master resource but does not appear as one of the codes for the resources in this resource family, then the selection will not be available for this resource family. No new resource selection codes may be defined here that are not defined in the master resource family. |
| Accessibility/ResourceFamily/Resource/Selection/Text | 0 or more | N/A | This is the container element for resource strings that are displayed in the user interface and validated in the file upload. |
| Accessibility/ ResourceFamily /Resource/Selection/Text/Language | 1 | Valid ISO 639-2 language code | The Language element indicates the language of this resource selection translation. At least one English (language=eng) is required. |
| Accessibility/ResourceFamily/Resource/Selection/Text/Label | 1 | String | The master resource selection label can be optionally overridden. If there is a Text group for selection override, them the Label must be provided at a minimum. |
| Accessibility/ResourceFamily/Resource/Selection/Description | 0 or 1 | String | The master resource selection description can be optionally overridden. |
| Accessibility/ResourceFamily/Resource/Selection/Message | 0 or 1 | String | The master resource selection message can be optionally overridden. |

Table . Configuration File XML Elements

# ART Configuration XML Validation

The ART Configuration XML file is validated by the validator against the XSD. Furthermore, it is validated against the business rules below.

## Validation Rules

**The following rules apply to resource definitions in the Master Resource Family and in Resource Families:**

* Resource codes and selection codes in Resource Families must be present in the Master Resource Family. No new resources or selections can be defined in subsequent Resource Families.
* If a resource defined in the Master Resource Family is completely omitted from a Resource Family, then the ART UI will inherit all text and selection information about the resource from the Master Resource Family. Position defined by the Order attribute.
* If a resource defined in the Master Resource Family is also present in a Resource Family, then:
  1. The code and English and translated text of the resource cannot be overridden
  2. The default code and translations for the resource may be overridden.
  3. No new codes can be created for a selection in a Resource Family that are not already provided in the Master Resource Family.
  4. The UI will only display resource selections that are repeated in the Resource Family for the resource and will not display any selections that are omitted for the resource in the Resource Family. This permits configuration of display of only certain selections and suppression of other selections for the subject/grade combination of a Resource Family.
  5. All text fields for resource selections defined int he Master Resource Family can be overridden in a Resource Family.

**The following rules apply to resource families:**

* Resource families are not strictly required. If the intent is that all subjects and grades get exactly the same resources and selections, then the configuration from the Master Resource Family will be used for all grades and subjects.
* The subject and grade(s) for a Resource Family must be defined in the Resource Family.
* Resource Families can be defined for some subjects and grades, but do not have to be provided for every possible subject and grade. The Master Resource Family will be used for any subject/grade combination for which there is no Resource Family defined.
* If a Resource Family is defined for a subject-grade combination that is already defined by a previous Resource Family, the second Resource Family will be ignored in favor of the settings of the first Resource Family that covers the particular subject-grade combination.
* No new codes can be defined in Resource Families that are not already defined in the Master Resource Family. Another way of looking at this is that new resources cannot be defined in Resource Families, only in the Master Resource Family.
* The following attributes for a resource defined in the Master Resource Family cannot be overridden: Code, Order Type, Text/Label, Text/Description. This restriction ensures consistency of the resource for tabular user interface and file upload formats. Only the resource default selection can be overridden.
* The following attributes for a resource selection cannot be overridden: Code, Order, Text/Label, Text/Description and Text/Message can all be overridden for resource selections.
* <order> must be a positive integer which cannot repeat in the file.
* Codes must be unique (resource and selection codes must not repeat)
* You cannot have 2 resource families that claim the same subject/grade combination, as that would create ambiguity.
* The default selection must appear as one of the resource selections.

## How to run the Validator

A command line shell script is executed in either Windows, Linux, or OS X. This script reads in a configuration file which contains information about the ART DB, XSD file, etc. The script validates the inputs and passes them to a stand-alone Java validator, which processes the XML, validates it, and loads the ART DB accordingly.

SCRIPT USAGE (Windows)*:*

validator.bat config\_file\_name

SCRIPT USAGE (Linux/Mac)

validator.sh [-c=config\_file\_name -b=basedir ...]

This script reads a config file named config\_file\_name that provides the following parameters:

basedir=(the base directory for the files and output log)

accomconfig=(the filename of the ART accommodations XML file)

xsd=(the filename of the XSD against which the XML will be validated)

mongohost=(FQDN of the host running Mongo DB)

mongouser=(Mongo username with write access)

mongopwd=(password of Mongo user)

mongodbname=(name of Mongo DB)

mongoport=(port of Mongo DB)

# Description of Changes

The following changes are required in ART.

1. A configuration artifact must be defined that meets the functionality required of Task Order 10.
2. An example configuration artifact must be constructed.
3. ART must be modified to read in this configuration on startup.
4. ART currently hard-codes the storage of accessibility resources and resource codes. ART must be changed to store the configured accessibility resources in its database and use a dynamic means of storing the accessibility resources and codes instead.
5. The Create/Modify Student user interface must be changed to offer accessibility resources dynamically based on the subject selected and the student’s enrolled grade.
6. The Designated Supports and Accommodations upload must be changed to validate upload files based on configuration and the subject and student’s enrolled grade.

# Risks

ART currently provides a hard-coded list of accessibility resources and selections that don’t change. Task Order 10 seeks to make that a variable mechanism. ART can clearly accommodate adding new accessibility resources, or adding new selections to existing accessibility resources. However, whenever an accessibility resource or selection is removed, there are consequences. This section highlights the circumstances where this can occur. There are downstream consequences to accommodation changes (such as new/changed codes) that must be harmonized with TDS, TIS, and Reporting.

|  |  |  |
| --- | --- | --- |
|  | Risk | Mitigation Strategy |
| 1 | The accessibility resource configuration file is changed to remove an accessibility resource or a resource selection. However, students have already been assigned accessibility resources that are no longer available in the configuration file. | 1. Prevent this from happening in the first place by ensuring the configured set of accessibility resources are set up and constant before assigning accessibility resource to students. 2. Use database tools to determine which students have improper codes then use ART upload files to remove the improper values. 3. Use database tools to remove improper values in the database. |
| 2 | Accessibility resources are defined for a student. However, the student’s enrolled grade is changed, and the new grade selects a different resource family. The student’s defined accessibility resources contain a resource or selection that is not appropriate for the new resource family. | 1. If the student’s enrolled grade is changed via the user interface, do not allow the student information to be saved until the improper resource or selection is changed. 2. If the student’s enrolled grade is changed via file upload, validate that all existing assigned accessibility resources are valid with respect to the new student enrolled grade. If not, issue a validation error and do not accept the change. If all accessibility resources are valid for the new grade, accept the change. |