Choosing the appropriate Audience Response System in different Use Cases

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ABSTRACT

Education in schools and universities suffers from different problems like the lack of interaction between the lecturer and the students as well as the fear of asking irrelevant questions or providing wrong answers in front of a large audience. A lot of systems exist that try to solve these issues by means of technical tools; e.g., audience response systems. Each of these individual systems supports different functional scopes with different didactic purposes in order to support specific use cases. For the lecturer, it is very hard to choose an appropriate system. Besides the functional scope, there are a lot of predefined limitations, such as a given room with technical restrictions or a favorite operating system and presentation software to present the slides. This paper gives an overview of fifty existing systems (with varying degree of detail) and proposes a filter mechanism based on the index card metaphor to select appropriate systems depending on their individual limitations. In order to simplify this selection process for the lecturer, the filter mechanism is implemented in a web-based selection tool.

Keywords: audience response systems, back channel systems, active learning, classification, selection support.

1. INTRODUCTION

Nelson Mandela once said, "Education is the most powerful weapon which you can use to change the world." As this was true in 1990, the issue of education in today's society is omnipresent. Schools and universities play the most important part in fulfilling this belief. While the importance of education is still true, the usage of traditional learning methods in schools and universities is not. Time and again the same problems occur; i.e., traditional lectures suffer from the limited interaction between the lecturer and the students as well as from students' fear to ask irrelevant questions or answer questions incorrectly in front of a large audience.

Digitalization has created new possibilities in order to address these issues. Using hardware devices ("clickers"), the students are able to answer predefined questions during the lecture, similar to the audience questions of "Who wants to be a millionaire?" The results are displayed on the screen and can be discussed with the audience afterwards. While the idea is revolutionary, the disadvantages of these systems range from high costs to time-consuming maintenance for distributing and loading the devices as well as the limited functional scope.

An alternative for these clicker systems are systems, which use the students' own devices. This "bring your own device" (BYOD) mantra benefits from low costs for the school or university and a simple maintenance. Since most of these systems are web-based, a large variety of devices is supported, and the functional scope is easy to extend. It reaches from simple poll questions that allow a communication channel to get feedback from the audience to live tweeting or back channel chats that provide the opportunity to allow asking questions or state issues as the lecture continues [1,2]. Different names for this kind of systems exist in literature; e.g., audience response systems (ARS), classroom response systems (CRS), or back channel systems. In the following, we will use *audience response system*. The intent of all these systems is still the same: supporting traditional classroom scenarios.

Since these systems are mostly chosen and organized by the school or university, lecturers need to adopt to them. This is not always possible due to predefined limitations; e.g., a given room with technical restrictions or a favorite operating system and presentation software to present slides [3,4]. This is the reason, why lecturers tend to use different audience response systems in their lectures. The selection of an appropriate system is not always trivial: it needs to consider all factors influencing the use-cycle. Since current overviews are strongly focused on the supported functional scope and are fixed in their provided selection criteria, our main goal will be the creation of an easy-to-extend method – using the metaphor of index cards – that is able to select audience response systems depending on a holistic view of different criteria.

Accordingly, this paper is structured as follows: In section 2, we briefly present background information about audience response systems and index cards. In section 3, possible factors influencing the selection process are discussed and aggregated in an index card. In section 4, fifty existing systems are – with varying degree of detail – filtered using these criteria. The results are displayed in a tabular overview and, in order to further simplify the selection process for the lecturer, processed and deposited in a web-based selection tool. Section 5 discusses limitations of the provided solution and section 6 concludes this paper with a short summary and view on future work.

2. BACKGROUND

Audience Response Systems
Audience Response Systems (ARS) provide an opportunity to increase the interaction between the lecturer and the students by means of technical tools. In order to describe the functional scope of these systems, a basic classification [5], which distinguishes between *digital front* and *digital back channel* functions, is presented. The classification is shown in Figure 1.
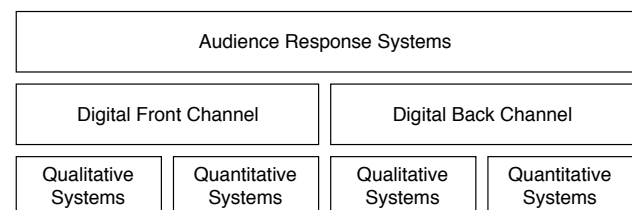

Fig. 1. Classification of ARS [5] [Translated into English]

Digital Front Channel: Its functions have an increased complexity which requires time to think. In order to ensure that each student has the ability to participate, an active break during the lecture is necessary to execute these functions and evaluate and present the results.

Qualitative Systems: Qualitative front channel functions allow the students to answer open ended questions[1]. An example for this kind of functions are evaluation questions asking for advantages and disadvantages of the lecture without providing predefined answer options.

Quantitative Systems: Quantitative front channel functions are used to ask the students to answer closed-ended questions[2]. E.g., this could be multiple choice questions with one or more correct answers in order to give students the possibility to check their gained knowledge and give the lecturer feedback about the current state of knowledge.

Digital Back Channel: Its functions differ from *digital front channel* as they are executed in the background of the lecture. In order to provide the possibility to answer or ask questions, no active break during the lecture is required.

Qualitative Systems: Qualitative back channel functions allow open-ended feedback. For example, free-text or graphical feedback systems (also known as "back channel" and "question-and-answer" systems) provide this kind of functions.

Quantitative Systems: Quantitative back channel functions allow students to choose from values of predefined feedback dimensions. An example for this kind of functions is instant-feedback which allows for rating the speed or volume of the lecturer immediately.

Index Cards

A suitable metaphor to comprehend the process and an easy-to-use method for filtering systems depending on a variety of attributes are *index cards*.

This method contains a *card for each system* and additionally *one reference card*. Every single card contains all selection criteria and provides a cell for every possible type of this criterion. The reference card is marked with a specific encoding using a *punch*. All other cards mark their possibilities with a punch, too.

Conveniently, it is possible to iterate all cards and compare them with the reference card in order to create a quick overview about all systems supporting the selected encoding of functionality. The idea is that the amount of systems reduces significantly with an increasing amount of selection criteria.

3. INDEX CARD FOR AUDIENCE RESPONSE SYSTEMS

In this section, we present an index card for choosing an appropriate audience response system. It contains selection criteria from two different views: the proprietary and the didactic view.

Selection Criteria

The functional scope is insufficient as sole selection criterion for choosing an appropriate system. It is necessary to consider the whole use-cycle from the proprietary view (e.g., how much does it cost, which languages are supported, or how does the setup work) to the didactic view which influences the actual preparation, execution, presentation, and post-processing stage of using the system.

Proprietary View: When choosing an appropriate system, one of the most obvious selection criteria is the price of the system. We can distinguish between *free* and *commercial systems*, where commercial systems can also provide a *free plan* or a *trial phase*. While a *free plan* allows the lecturer to use the system with a few limitations, *trial phases* are limited in time. Hence, we will only distinguish between *commercial* and *commercial systems with free plan*. Additionally, whether a system is *open source* or not, is important to consider.

The next obvious selection criterion is the languages, supported by the system. For simplicity, we distinguish between *Chinese*, *Spanish*, *English*, and *German*. The addition of *further languages* needs to be considered.

To actually use a system, its setup has to be investigated. There exist systems providing a *public server*, an *extension of an external system*, or the possibility to run the system on an *own server*.

In order to provide the possibility to manage contents between systems, the import and export options should also be considered. The best-known formats for describing online material, such as quiz questions, are *GIFT* (General Import Format Template), *IMS QTI* (IMS Question & Test Interoperability) and *Moodle XML*. *Other formats*, such as custom formats that are system specific, also need be respected.

Didactic View: One of the main questions is the overall scenario that should be supported. Systems for supporting *school*, *university*, and *single event-scenarios* exist.

Besides this, the functional scope is relevant. Using the classification that is shown in Figure 1, we distinguish between systems supporting *qualitative front channel*, *quantitative front channel*, *qualitative back channel*, and *quantitative back channel* functions.

Finally, it is also mandatory to consider how the lecture collaborates with different stages within the system. We distinguish between *content creation*, in which functions are created by the lecturer, *content execution*, in which students execute the created functions, as well as the *content presentation* in order to show the immediate results of the function execution. For each stage, the same expressions can be found again. While most of these systems are *web-based*, some also provide possibilities to use *mobile applications*, the *presentation software* itself or *other options* like a software running on the operating system or the usage of SMS.

For the post-processing of these functions, it is mandatory to consider, whether the system allows the *content evaluation* for *lecturers* and *students*.

Index Card for Audience Response Systems

The selection criteria, discussed above, are displayed in Figure 2 using the index card metaphor, which allows an easy-to-use filtering of audience response systems depending on a variety of attributes. The distinction between selection criteria of the proprietary and the didactic view is the main part of this index card. Each criterion is displayed as a rectangle. Using simple subdivisions, every possible expression of this criterion is displayed, which allows for being punched later on. In order to avoid complexity when considering criteria with the same expressions, a table display is used to summarize them. Furthermore, expressions that seem to be too specific were summarized in a subdivision called "other".

It is important to note that this index card can be easily adjusted or extended by further selection criteria or expressions in order to match even more specific use cases.

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[1] E.g., questions that require a free-text or a graphical answer (by creating a graphic in an online white-board).

[2] Questions that have predefined answer choices.

Proprietary View				Didactic View			
Costs			Content \ Type	Web Application	Mobile Application	Presentation Application	Other
Free	Commercial	Commercial with Free Plan	Content Creation				
Open Source			Content Execution				
Language			Content Presentation				
Chinese	Spanish	English	...	German	**Content Evaluation**		
Server Setup			Student		Lecturer		
Public Server	Extension of External System	Own Server	**Functional Scope**				
Type \ Format	GIFT	IMS QTI	Moodle XML	Other	Qualitative Front Channel	Quantitative Front Channel	Qualitative Back Channel	Quantitative Back Channel
Import					**Scenario**		
Export					School	University	Event

Fig. 2. Index card for choosing appropriate audience response systems for specific use cases.

4. CHOOSING AN APPROPRIATE SYSTEM

In this section, we apply the previously created index card to a subset of fifty existing systems. The results are displayed in tabular form. In addition, a web-based tool, which simplifies the selection process, is introduced.

Existing Audience Response Systems

There are numerous overviews of existing audience response systems; e.g., [6,7,8]. Since most of these overviews only focus on a small subset of possible selection criteria, such as the supported functional scope, they lack at providing a holistic view on such systems. Moreover, all of the above-mentioned overviews investigate also full commercial systems, which make it very hard to extend them by further selection criteria.

In order to get the actual information about the system and to give every lecturer the possibility to use the provided systems, our approach focuses on *free systems* on one side, and on *commercial systems that provide a free plan* on the other side. *Fully commercial systems* and *commercial systems that only provide a free trial* will not be considered. The investigated systems were retrieved by the above listed survey papers [6,7,8] as well as by additional research which delivered also some systems that were not yet present in these papers.

It is important to note that this overview is – regardless of its comprehensiveness – incomplete; it just provides a subset (ideally a majority) of existing systems.

Free Audience Response Systems: A variety of *free* audience response systems exist: AMCS [9], AnswerGarden [10], ARSenic [11], ARSnova.app [12], ARSnova.click [13], ARSServer [14], AuResS [15], Backchannel [16], Backstage 2.0 [17], ClassQuestion [18], Cliqr [19], DirectPoll [20], FreeMobilePolls [21], FreeQuizDome [22], Graphicuss [23], Invote [24], IPAL [25], Lexsury [26], MARS [27], MobileQuiz [28], PINGO [29], Plickers [30], PollToGo [31], SMILE [32], Sturesy [33], Tweedback [34], UniDoodle [35], and Voxvote [36].

Commercial Audience Response Systems with Free Plan: There also exist a lot of *commercial* audience response systems that provide a *free plan*, which limits the functional scope or the number of participants which are allowed to execute functions: AskVote [37], ClassClicker [38], Crowdsignal [39], Feedbackr [40], Formative [41], GoSoapBox [42], Kahoot! [43], Mentimeter [44], Nearpod [45], OnlineTED [46], PollEverywhere [47], Quizlet [48], Sendsteps [49], Shakespeak [50], Sli.do [51], SlideLizard [52], SMSPOLL [53], Socrative [54], Swipe [55], TEDME [56], TheAnswerPad [57], and Wooclap [58].

Classification Table

The systems listed above are categorized using the index card for audience response systems. For *commercial systems that provide a free plan,* it is important to note that we only considered the resulting limited functional scope. In order to allow a more granular distinction, whether a subcriterion is supported or not, we distinguish between *fully* and *partly* supported features. Features that are not supported were left blank in order to increase the clarity. The results are displayed in Table 1.

Observations show that the variety of the investigated systems focuses on web-based solutions which are accessible on a public server. Only a few systems provide native applications for tasks within the system that are done by either students, lecturers or both, or provide support for the content creation task using a presentation software. The installation on an own server or the extension of external systems is also only supported by a minority of systems. Related on the functional scope, it can be observed that most of the systems support the quantitative front channel functionality, while other types of functions are much less supported. Finally, it is recognizable that only some systems support the import and export of content and results, whereas most of these systems use custom formats instead of standardized assessment formats like GIFT, IMS QTI or Moodle XML.

Table 1. Classification based on the index card for audience response systems for a majority of 50 audience response systems. We differentiate between fully (■) and partly (⊞) supported features. Features that are not supported are left blank.

System	Free	Commercial	Commercial w/ Free Plan	Open Source	Chinese	Spanish	English	German	Public Server	Ext. of external System	Own Server	Import GIFT	Import IMS QTI	Import Moodle XML	Import Other	Export GIFT	Export IMS QTI	Export Moodle XML	Export Other	Creation Web App	Creation Mobile App	Creation Presentation SW	Creation Other	Execution Web App	Execution Mobile App	Execution Presentation SW	Execution Other	Result Web App	Result Mobile App	Result Presentation SW	Result Other	Student	Lecturer	Qual Front	Quant Front	Qual Back	Quant Back	School	University	Event
AMCS	■						■	■	■				■						■	■		⊞		■	■			■		⊞		■	■	■	■			⊞	■	⊞
AnswerGarden	■						■		■										■	■	■	⊞		■	⊞			■	⊞								■	⊞	⊞	■
ARSenic	■			■			■		⊞		■									■				■				■								⊞		⊞	⊞	
ARSnova.app	■			■			■	■	■		■				■				■	■		⊞		■				■	⊞			■	■	■	■	■	■	⊞	⊞	■
ARSnova.click	■			■		■	■	■	■		■				■				■	■				■				■								■		■		
ARSServer	■			⊞			■				■									■				■				■									⊞		⊞	⊞
AskVote		■	■				■		■											■				■				■									■		⊞	⊞
AuResS	■			■			■		■										■	■				■				■						⊞	⊞			⊞		⊞
Backchannel	■						■		■											■				■				■									■	■	⊞	⊞
Backstage 2.0	■						■		■											■				■				■				■	■	■	■			⊞	■	
ClassClicker		■	■				■		■						■					■				■				■							⊞	⊞			⊞	■
ClassQuestion	■						■		■						■					■				■				■				■	■		■				⊞	
Cliqr	■			■				■		⊞										■				■				■							■				⊞	
Crowdsignal		■	■		■	■	■	■	■						⊞					■				■				■						⊞	⊞	■	■		⊞	⊞
DirectPoll	■						■		■											■				■				■	⊞						■			⊞	⊞	⊞
Feedbackr		■	⊞				■	■	■						■				■	■				■				■			⊞	■			■			⊞	⊞	⊞
Formative		■	■				■		■						■					⊞	■			■				■				⊞	■	■	■			■	⊞	
FreeMobilePolls	■						■		■											■				■				■							■					⊞
FreeQuizDome	■			⊞			■	■	■		⊞			■					■			■	■	■						■		■	■	■	■			⊞	⊞	
GoSoapBox		■	■				■		■						■					■				■				■	⊞			■	■	■	■	■	⊞	⊞	⊞	■
Graphicuss	■						■		■											■				■				■							■			⊞	■	
Invote	■						■	■	■						■					■			■	■				■				■		■	■				⊞	⊞
IPAL	■			■			■			■					■					■			■	■				■				⊞	■	■				⊞	■	
Kahoot!		■	■				■		■						■					■	■			■	■			■	■					■			⊞	■	⊞	⊞
Lexsury	■						■		■											■				■				■									■		⊞	⊞
MARS	■			■			■			⊞	■				■				■	■				■				■						⊞		■		⊞	⊞	
Mentimeter		■	■				■		■										■	■		■		■	■	■		■		⊞	■	■		■	■	⊞	⊞	⊞	⊞	⊞
MobileQuiz	■			■			■	■		⊞					■					■				■				■				⊞	⊞	■				⊞	⊞	
Nearpod		■	■				■		■						■					■	■			■	■			■	■			⊞	■	■	■			■	⊞	
OnlineTED		■	■				■	■	■											■				■				■				⊞		■				■	⊞	
PINGO	■			■			■	■	■			■	■	■	■	■	■	■	■	■				■				■			⊞	⊞	■	■		■		⊞	⊞	⊞
Plickers	■						■															■					■			■			⊞		■			■		⊞
Polleverywhere		■	■				■		■						■					■	■	■		■	■			■	■	■		⊞	■	■	■	■		⊞	■	■
Polltogo	■						■		■											■	■			■				■	■			⊞	⊞	■	■	⊞		⊞	⊞	
Quizlet		■	■		■	■	■	■	■						■					■	■	■		■	■			■	■			⊞	⊞	■	■			■	■	
Sendsteps		■	■				■		■													■		■		■				■				■	■				⊞	⊞
Shakespeak		■	■				■		■													■		■		■				■				■	■				⊞	⊞
Sli.do		■	■				■		■											■	■	⊞	■	■	■			■	■	⊞	■	■	■	■	■	■	⊞	⊞	⊞	■
SlideLizard		■	■				■	■	■													■		■	■					■				■	■	⊞		⊞	⊞	■
SMILE	■						■	■	⊞											■				■				■				⊞	⊞	■	■	■	■	⊞	■	
SMSPOLL		■	■				■		■											■				■		■				■				■						⊞
Socrative		■	■				■		■					⊞					⊞	■	■			■	■			■				⊞		■	■			■	■	■
Sturesy	■			■		■	■	■			■		■		■				■	■							■				■		■	⊞	■	■		⊞	⊞	
Swipe		■	■				■		■						■				■	■				■				■				⊞	⊞	■				■	■	⊞
TEDME		■	■				■	■	■											■				■				■				⊞		■	■			⊞	■	
TheAnswerPad		■	■				■		■						⊞					■	■			■				■				⊞	■	■	■			■	■	
Tweedback	■						■	■	■											■				■				■						■	■	■	■	⊞	⊞	⊞
UniDoodle	■						■		■													■		■		■				■		⊞	⊞	■	■			⊞	⊞	
Voxvote	■					■	■	■	■											■				■				■				⊞		■				⊞	⊞	⊞
Wooclap		■	■		■	■	■	■	■			■		■	■					■				■				■				⊞	■	■				⊞	⊞	■

Web-based Selection Tool

In order to provide the possibility to select appropriate audience response systems within a short amount of time, the results of Table 1 were processed and deposited in a web-based selection tool. For every system the link as well as the name and the icon were retrieved. Using a combination of the *Angular*[3] seed project *Angular CLI*[4] and the front-end library *Bootstrap*[5], the systems are displayed within a responsive grid, which allows the access from the variety of different devices. Clicking on a specific system opens it in a new tab.

Within this tool, it is possible to combine multiple filters of the different selection criteria that are displayed in the sidebar for large devices or as an overlay on small, mobile devices. Before clicking a filter button, the number of resulting systems is already displayed in brackets. After clicking a filter button, the list of audience response systems decreases to the amount of appropriate systems matching these criteria. An example of this selection process is shown in Figure 3, where all free audience response systems that provide a public server are selected. Afterwards, it is possible to apply further filters to reduce the list even more.
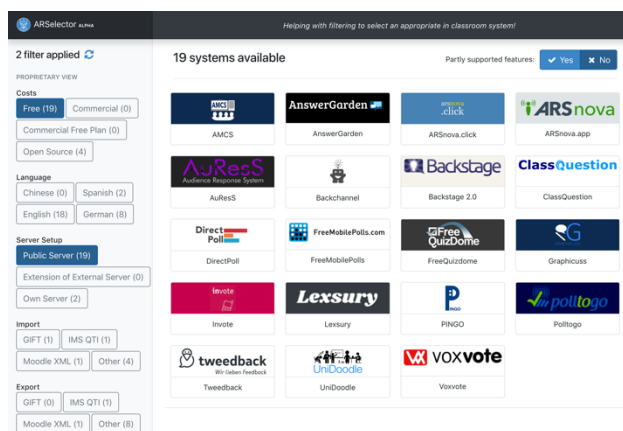
Fig. 3. Desktop view of ARSelector – a web-based audience response selection tool.

In order to provide access to partly supported features, a switch button to enable and disable them is added. To get information about the filter process and to restart it, the number of filters applied, and a reset button are added to the sidebar. This results is an easy-to-use selection tool that can be extended by further tools or selection criteria without much effort. The system is freely accessible at https://www.rn.inf.tu-dresden.de/arselector/ [6].

5. LIMITATIONS

The index card displayed in Figure 2 represents only one possible subdivision of selection criteria for audience response systems. In order to keep it simple and clear enough, some types of expressions such as different types of mobile applications or presentation software were omitted. Other types like the variety of supported languages were shortened and can be adopted to the user needs.

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[3] Open-source front-end web application platform based on TypeScript
[4] https://github.com/angular/angular-cli – accessed 5 December 2018
[5] https://getbootstrap.com/ – accessed 5 December 2018
[6] Last accessed on 5 December 2018

With regard to the classification done in Table 1, it is important to note that only free systems and commercial systems which provide a free plan were considered. Also, it is important to know that the list of systems provided does not represent a complete and general overview – more a majority of existing systems. Additionally, the classification does not guarantee agreement in every single cell – some types cannot be assigned definitely; other types strongly depend on the actual user that does the classification.

The provided web-based tool is currently still work-in-progress and can be extended or refined at any time. At the moment, only the basic functionality, which was explained above, is provided.

6. CONCLUSION AND FUTURE WORK

In this paper, we presented multiple contributions to ease the selection process of audience response systems. An extensible index card method for choosing an appropriate audience response system for specific use cases was presented. In order to show the applicability of this method, a classification for a subset of fifty free and commercial systems with free plan was conducted. As we could observe, there is no specific system appropriate for every possible use case. An individual selection process is needed to select a system that is able to meet own expectations. To support the selection process, the work-in-progress of a web-based filter tool for audience response systems was presented.

In the future, the extension of the index card needs to be investigated. In order to match specific user groups, different variants of this index card could be created. To provide even more support for the lecturer, the web-based filter tool needs to be adjusted by a more compact overview of selection criteria, short descriptions of different systems as well as the ability to create own filter rules for the selection.

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