
ICT-687655

Delivering Single and Multi-Screen Content Services for Immersive, Customised and Shared Experiences in Homes and Social Spaces



2IMMERSE

D3.5 User Experience Results: Interactions for Theatre in Schools

Due date of deliverable: September 2018

Actual submission date: January 2019

Start date of project: 1 December 2015

Duration: 36 months

Lead contractor for this deliverable: BBC

Version 15 December 2019

Confidentiality status: Public

Abstract

This document describes the User Interaction Design work for the *Theatre in School* prototype, which builds on the previous UX-design work for the *Theatre at Home*, *MotoGP* and *Football at Home* and *Football FanZone* prototypes. This document also reports generic UX-principles which have developed through the 2-IMMERSE project, and which have helped defined the components and features used in all the service trials.

Target audience

This document is for public dissemination and is intended primarily for those with good background knowledge of media delivery systems and who are knowledgeable of user requirements in the target scenario areas.

Disclaimer

This document contains material, which is the copyright of certain 2-IMMERSE consortium parties, and may not be reproduced or copied without permission. All 2-IMMERSE consortium parties have agreed to full publication of this document. The commercial use of any information contained in this document may require a license from the proprietor of that information.

Neither the 2-IMMERSE consortium as a whole, nor a certain party of the 2-IMMERSE consortium warrant that the information contained in this document is capable of use, or that use of the information is free from risk, and accept no liability for loss or damage suffered by any person using this information.

This document does not represent the opinion of the European Community, and the European Community is not responsible for any use that might be made of its content.

Impressum

Full project title: 2-IMMERSE

Title of the workpackage: WP3 User Interaction Design

Document title: D3.5 User Interaction Design: the development of generic components and features to inform the *Theatre in Schools* prototype, and a summary of 2-IMMERSE UX-principles.

Editor: Maxine Glancy BBC

Workpackage Leader: Maxine Glancy, BBC

Project Co-ordinator: Matt Scarth BBC

Technical Project Leader: Doug Williams, BT

This project is co-funded by the European Union through the ICT programme under FP7.

Executive Summary

The 2-IMMERSE project set out to create and pilot service prototypes presented across multiple screens. New multi-screen services have been designed to merge content from broadcast and broadband sources and support new visualisations, viewpoints, data and replay facilities in addition to social network functionality such as chatting, commenting, polling etc.

The reporting framework throughout the 2-IMMERSE project is structured so that we can give methodical, iterative feedback. Therefore, WP3 deliverables outline ‘best practice’ for UX-design and testing strategy - what we have done, and what we want to do next in terms of design aspirations and capabilities.

D3.1 reported on a group of small studies to inform and ground the overall UX design for the platform. For example, establishing synchronization parameters across devices.

D3.2 reported on UX-design of the *Theatre at Home* service. For example, audience requirements gathering, and establishing basic screen layout design across devices.

D3.3 described the user interaction design and experimentation work that informed the design of the *MotoGP* service experience, and specifically the subset of those features tested with connected audiences in private homes. It also reported on the design of the 2-IMMERSE *Live Production Tools*, used in the live-end-to-end trial, and the design of the *SetUp* and *OnBoarding* process.

D3.4 reported on the design and experimentation work that informed the *Football at Home* and *Football Famzone* service experiences, tested in the live-end-to-end trial and presented at IBC’18.

D3.4 also described the design of the 2-IMMERSE *Pre-Production Tools*, and the design of the *OnBoarding: Unified Launcher*.

This document, D3.5, describes the work that informed the design of the *Theatre in Schools* service proposal, and specifically the subset of features to be tested with connected users in schools, prompted by and developed since the *Theatre at Home*, *MotoGP* and *Football at Home* and *Football Fanone* experiences.

This multi screen experience is highly visual. Readers are alerted to a video that describes and illustrates the *Theatre in Schools* experience. The videos is accessible via the 2-IMMERSE web site: www.2immerse.eu

The designs described in this document were subsequently evaluated in live tests in three schools across the UK. The results of this evaluation are reported in a different document, D4.7.

As the final deliverable from WP3 we also report here a consolidated view on the principles that have been used to guide the development of the design process. We identify a range of principles that we describe in heirarchical form and that include principles related to scope and resource; principles related to Producer goals; principles related to the role of the Director; and principles related to User Needs.

Finally, user interaction design principles that have informed user experiences generic to all service trials, are summarised. The methods used in WP3 include conceptual design, trajectory mapping, surveys and lab experiments. This deliverable covers the work and the thinking that led to the development of the service trial. It does not cover the test methodology or the results of the trial which are covered in WP4 documentation, or the technical development of the Production Tools detailed in WP5.

The Annex to this document describes a supplementary study exploring the user requirements of an integrated augmented reality experience, with closely synchronised content across a shared TV screen and a head mounted display, specifically aimed at audiences with auditory impairments.

List of Authors

BBC: Maxine Glancy
BBC: Vinoba Vinayagamoorthy
BT: Andy Gower
BT: Martin Trimby
BT: Doug Williams
Illuminations: John Wyver
Illuminations: Amanda Gower
IRT: Christoph Ziegler

Reviewer

BT: Doug Williams
Illuminations: John Wyver

Table of Contents

Executive Summary	3
List of Authors	4
1 Introduction	11
2 Theatre in Schools	12
2.1 Proposal	12
2.1.1 Social Context (excerpt from D4.1).....	12
2.2 Background Research	13
2.2.1 Concept development.....	15
2.3 Introducing Donmar Warehouse	16
2.3.1 Workshops with the Donmar Education Team in Schools.....	18
2.3.2 Aligning the aims of 2-IMMERSE and the Donmar.....	19
2.4 Developing the <i>Theatre in Schools</i> Prototype	22
2.4.1 Process.....	23
2.5 Design Criteria	23
2.6 Goals	23
3 Concept development - Overview	25
3.1 Lesson structure	25
3.2 Affordances of technical capabilities	26
3.3 Potential student activities	26
3.4 Lesson ideas - long list	27
3.5 Scenario Development	27
3.6 Technical requirements	28
3.7 The ‘Watch / Make / Share’ framework	29
3.8 Achieving flexibility using the framework	29
3.8.1 Flexibility with regards to the overall timing.....	29
3.8.2 Flexibility within the Watch section.....	30
3.8.3 Flexibility within the Make section.....	30
3.8.4 Flexibility within the Share section.....	30
3.9 Lesson topics and structure	30
4 Story Builder - Prototype Service Descriptions	32
4.1 Story Builder - Learning objectives	32
4.2 Story Builder - Source material	32
4.3 Story Builder - Common features across the lessons	32
4.4 Story Builder - Lesson timeline	34
4.5 Story Builder - Left menu	35
4.6 Story Builder - Watch - Overview	36
4.7 Story Builder - Watch - Interface features	38
4.8 Story Builder - Make - Overview	43
4.9 Story Builder - Make - Interface features	45
4.9.1 The teacher companion screen interface features:.....	45
4.9.2 The student companion screen interface features:.....	48
4.9.3 The shared display (TV) interface features:.....	49
4.10 Story Builder - Share - Overview	50
4.11 Story Builder - Share - Interface features	52
4.11.1 The teacher companion screen interface features:.....	52
4.11.2 The student companion screen interface features:.....	54
4.11.3 The shared display (TV) interface features:.....	55
5 Script Detective - Prototype Service Description	57

5.1	Script Detective - Learning objectives	57
5.2	Script Detective - Source material.....	57
5.3	Script Detective - Common features across the lessons.....	57
5.4	Script Detective - Lesson timeline.....	57
5.5	Script Detective - Left menu	58
5.6	Script Detective - Watch - overview.....	59
5.7	Script Detective - Watch interface features	61
5.7.1	The teacher companion screen interface features	61
5.7.2	The student companion screen interface features	63
5.7.3	The shared display (TV) interface features:.....	65
5.8	Script Detective - Make - Overview.....	66
5.9	Make interface features.....	69
5.9.1	The teacher companion screen interface features	69
5.9.2	The student companion screen interface features	71
5.9.3	The shared display (TV) interface features:.....	73
5.10	Script Detective - Share - Overview.....	74
5.11	Share Interface features	76
5.11.1	The teacher companion screen interface features	76
5.11.2	The student companion screen interface features	78
5.11.3	The shared display (TV) interface features	80
6	New Service Prototype Development - Summary	81
6.1	Existing capabilities:.....	81
6.2	New capabilities:.....	81
6.3	Longer term aims or objectives that could not be realised during the project	82
7	UX principles and recommendations for the development of multi-screen object-based experiences.....	83
7.1	Principles: the origin of principles, principle sources and groups.....	83
7.1.1	Principles related to scope and resource.....	83
7.1.2	Principles related to Producer goals.....	84
7.1.3	Principles related to the role of the Director	85
7.1.4	Principle related to User Needs	85
7.2	Inherited design principles.....	86
7.2.1	Design principles for iOS.....	86
7.2.2	Design principles from the UK government's Design Service	86
7.2.3	Principles from previous service trials.....	87
7.3	A hierarchy of Design principles.....	87
7.4	Accessibility	89
7.5	UX insights and areas for future exploration	90
7.5.1	Audio level management.....	90
7.5.2	Orchestration of user attention.....	90
7.5.3	Prompted configuration.....	90
7.5.4	Value of personalisation.....	90
7.5.5	Companion device functional parity	90
7.5.6	Replay provision.....	91
7.5.7	Replay on TV with PiP and transitions	91
7.5.8	Graphics development workflow approaches.....	91
7.5.9	Editing and customising content and offering interactivity.....	91
7.5.10	Use generated content	91
7.5.11	Persistence	91
7.5.12	Checking for understanding	91

8	Conclusions	92
Annex A	Supplementary Work.....	93
	Personalising the TV Experience with Augmented Reality Technology: Synchronised Sign Language Interpretation. (IRT & BBC)	93
	Accessibility and the TV.....	93
	The Use Case: Sign Language delivered in AR.....	94
	Capturing Content	95
	Direction of Gaze –Designing with the Interpreter	95
	Ensuring Synchronisation Interaction	96
	Signing Space.....	96
	Placement of Content in AR.....	96
	Prominence and Presentation of the Interpreter	96
	Signing Quality & Techniques.....	96
	Size, Position and Scale	97
	Distance & Overlap.....	98
	Choosing the Interpreters’ Direction of Gaze	98
	Discussion.....	98
	Limitations.....	98
	Conclusion and Future Work	99
	References.....	99

Table of figures

Figure 1 Early visualisation of the <i>Theatre in Schools</i> experience.....	12
Figure 2 RSC Schools Broadcasts website, NT Live website.	13
Figure 3 RSC School Broadcasts (images supplied by RSC) showing different settings in which schools broadcasts are presented (blurry images ensure GDPR compliance).	13
Figure 4 Zone of Proximal Development: nurturing and guiding to fulfill potential	14
Figure 5 Bloom’s Taxonomy: about creativity as a starting point vs. rote learning	15
Figure 6 Images from an ideation session at the BBC with 2-IMMERSE team members and students on placement to BBC R&D.....	16
Figure 7 Image from a technical review: ideas from the ideation session were presented to members of the 2-IMMERSE development team and reviewed against 2-IMMERSE technical goals.....	16
Figure 8 The Donmar education team introduce the presentations from two participating schools, the culmination of 6 weeks of workshops.....	18
Figure 9 Examples of the postcards on which students completed the sentence ‘I want to make a piece of theatre that....’	18
Figure 10 Concept illustrating how multiple screens could be used to view the synchronized perspectives of different characters.....	19
Figure 11 Concept illustration of an ‘Activity Selector’ for teachers. This concept shows how teachers could discover resources developed by Donmar to achieve certain learning goals.....	20
Figure 12 The ‘Synopsis Builder’ concept is based on an activity in which students capture a physical pose to illustrate key plot-points (to develop choreography ideas, and to internalise the lines and plot).	21
Figure 13 A conceptual illustration of The Synopsis Builder playlist (later to be the StoryBuilder), which students share with peers to illustrate their ‘key plot points’ from the synopsis.....	21
Figure 14 Donmar Warehouse - Shakespeare Trilogy website.....	22
Figure 15 Lesson Timeline – Chapters	25
Figure 16 Early Scenario Development – Team Activity.....	28
Figure 17 Showing examples of the three screen types, the shared display, the teacher tablet and the student tablet.	33
Figure 18 Tablet Interface - Layout, illustrating the status bar, left menu and main panel	34
Figure 19 Lesson Timeline – Illustrating how the teacher can enforce progression by selecting the next section in the Watch / Make / Share structure. In this example ‘Watch’ is selected	35
Figure 20 Reference Material – Character Family Tree, accessed from the left menu.....	36
Figure 21 Watch Interface - <i>Julius Caesar Plot</i> Video illustrating the titled bookmarks across the bottom of the video	37
Figure 22 Watch Interface - Synchronised Video and Stills illustrating how the teacher can, using the teacher companion app, control what appears on the pupils’ tablets. In this case “stills” are selected and the pupils see relevant stills from the scene rather than video.	37
Figure 23 Watch Interface - Synchronised Vote Results	38
Figure 24 Watch - Teacher Companion Screen – Video	38
Figure 25 Watch - Teacher Companion Screen – Vote	39

Figure 26 Watch - Student Companion Screen - Video.....	40
Figure 27 Watch - Student Companion Screen - Stills	41
Figure 28 Watch - Student Companion Screen - Cast Vote.....	41
Figure 29 Watch - Student Companion Screen - Vote Results.....	42
Figure 30 Watch – Shared Display - Video - Timeline On.....	43
Figure 31 Watch – Shared Display - Media – Vote	43
Figure 32 Make Interface – Teacher Task View - Student Story Select.....	44
Figure 33 Make Interface – Teacher Group View - Student Story Select	44
Figure 34 Make Interface – Teacher Group View - Student Edit.....	45
Figure 35 Make - Teacher Companion Screen – Task 1	46
Figure 36 Make - Teacher Companion Screen - Whiteboard	46
Figure 37 Make - Teacher Companion Screen – Group Progress All	47
Figure 38 Make - Teacher Companion Screen – Group Progress Group 1	47
Figure 39 Make - Student Companion Screen – Story Panel.....	48
Figure 40 Make - Student Companion Screen – Story Playlist Edit.....	49
Figure 41 Make – Shared Display – Media - Task Description.....	49
Figure 42 Make – Shared Display – Media – Whiteboard.....	50
Figure 43 Share Interface – Teacher Preview – Displays on Standby	51
Figure 44 Share Interface – Teacher Select Group 1 – Student Group 1 Player.....	51
Figure 45 Share Interface – Teacher Select Group 1 – Student Group 2 Viewer	52
Figure 46 Share - Teacher Companion Screen – Video.....	53
Figure 47 Share - Teacher Companion Screen – Group Storyboard.....	53
Figure 48 Share - Student Companion Screen – Player.....	54
Figure 49 Share - Student Companion Screen – Viewer	55
Figure 50 Share – Shared Display - Standby	55
Figure 51 Share – Shared Display – Video	56
Figure 52 Lesson Timeline – Watch Selected.....	58
Figure 53 Reference Material – Literary Devices and Definitions	59
Figure 54 Watch Interface - <i>'Friends, Romans, Countrymen' Insight Video</i>	59
Figure 55 Watch Interface - Synchronised Video and Stills.....	60
Figure 56 Watch Interface – Voting Display Results	60
Figure 57 Watch - Teacher Companion Screen – Video	62
Figure 58 Watch - Teacher Companion Screen – Vote	62
Figure 59 Watch - Student Companion Screen - Video.....	63
Figure 60 Watch - Student Companion Screen - Stills	64
Figure 61 Watch - Student Companion Screen - Cast Vote.....	64
Figure 62 Watch - Student Companion Screen - Vote Results.....	65

Figure 63 Watch – Shared Display - Video - Timeline On.....	66
Figure 64 Watch – Shared Display - Media - Vote.....	66
Figure 65 Make Interface – Teacher Instructions - Student Speech Selection	67
Figure 66 Make Interface – Teacher Group Overview - Student Speech Edit	68
Figure 67 Make Interface – Teacher Single Group View - Student Edit.....	68
Figure 68 Make - Teacher Companion Screen – Task 1	70
Figure 69 Make - Teacher Companion Screen - Whiteboard	70
Figure 70 Make - Teacher Companion Screen – Group Progress All	71
Figure 71 Make - Teacher Companion Screen – Group Progress Group 1	71
Figure 72 Make - Student Companion Screen – Speech Select.....	72
Figure 73 Make - Student Companion Screen – Speech Playlist Edit.....	73
Figure 74 Make – Shared Display – Media - Task Description.....	73
Figure 75 Make – Shared Display – Media – Devices and Emotions Reminder.....	74
Figure 76 Share Interface – Teacher Select All – Aggregated Annotations	75
Figure 77 Share Interface – Teacher Select All – Student Standby	75
Figure 78 Share Interface – Teacher Select Group 4 - Student Group 4 Player	76
Figure 79 Share - Teacher Companion Screen – Group 4 Selected.....	77
Figure 80 Share - Teacher Companion Screen – All Selected.....	78
Figure 81 Share - Student Companion Screen – Group 4 Selected - Player.....	79
Figure 82 Share - Student Companion Screen – All Selected – Player.....	79
Figure 83 Share – Shared Display – Group 4 Selected – Video – Group List.....	80
Figure 84 Share – Shared Display – All Selected – Video – Temporal List.....	80
Figure 85 Original UX-designs for <i>Theatre at Home</i> , explored the shared TV screen with text chat window (upper image) and without a text chat window (lower image).....	84
Figure 86 <i>MotoGP</i> graphic regions defined by BT Sport and Dorna.	85
Figure 87 Capturing the interpreter using blue LED lights and Chromatte (reflective cloth) at BBC R&D.	94
Figure 88 Capturing the interpreter using a green studio set-up at IRT.....	95
Figure 89 In-Vision interpreter as seen on a typical interpreted content piece.....	95
Figure 90: Half Body Signer – View through the HoloLens. The user sees the half body signer ‘sitting’ on the TV stand on the right hand side of the TV	97
Figure 91: Full Body Signer – View through the HoloLens. The user sees the signer ‘standing’ on the floor on the right hand side of the TV.....	98

1 Introduction

This deliverable describes the ‘back-story’ that influenced the development of the Theatre In Schools service prototype and hence the 2-IMMERSE platform.

In general, platform features are developed in response to a design requirement that comes from a particular service prototype. The general approach of the project is to build the platform to meet the requirements set by our service prototypes. As expected, we have found that the features and capabilities developed for one service prototype are being used in others.

The WP3 documents are structured by service prototype, as this is the way the development within the project was phased. It should not be interpreted that the features and functions described under the heading of a particular service prototype are only used for that service prototype, as this is not the case.

In Chapter 2 we review the background UX-design work behind the *Theatre in Schools* prototype and service trial. This includes an introduction to the parties involved and in particular The Donmar Warehouse. It also includes a description of the drivers design criteria and principles that steered the design process.

In Chapter 3 we look at some foreground processes that were used to define the lesson structures in more detail. This includes the development of ‘long lists’ of potential student activities and potential lesson topics. It also introduces a common lesson structure (Watch / Make / Share) that was developed as a useful framework for the three proposed lessons. The three lesson ideas that were proposed were Story Builder (to help with understanding of plot), Script Detective (to help with understanding of rhetorical devices) and Profile Creator (to help with an analysis of character). Two of these lesson ideas were developed and are described in chapters 4 and 5. These two chapters have the same structure. They each describe: the learning objectives; the source material used to develop the lessons; the common interface features used in all stages of the lesson; the appearance and function of the interfaces for the three stages of the lesson across all the available screens.

This multi screen experience described here are highly visual. Readers are alerted to a video that describes and illustrates the Theatre in Schools experience. The video is accessible via the 2-IMMERSE web site: www.2immerse.eu

Chapter 6 summarises which 2-IMMERSE technical platform features were already available and which new features had to be developed to meet the needs of this new service prototype.

This document does not describe the evaluation of these use cases. Both lessons were tested in schools and an extensive account of the evaluation in schools is available in another deliverable D4.7

Chapter 7 we summarise the UX-design principles that have informed the user experiences in the 2-IMMERSE service trials.

Chapter 8 provides some conclusions drawn from this work.

The approach taken within 2-IMMERSE, that allows content to be personalised, has obvious applications for accessibility. We have always been aware of this and in general we have adopted the “this is for everyone” principle but in the Annex we describe some a supplementary study related to accessibility for audiences with auditory impairments. Specifically it explores different ways of presenting integrated augmented reality signing options.

2 Theatre in Schools

This chapter describes the UX-design and development work for the *Theatre in Schools* service trial. Starting with a description of the original proposal and early background research, the chapter then outlines the work carried out with the Donmar Warehouse theatre company leading to the final *Theatre in Schools* prototype. This prototype was trialled and evaluated in three UK schools.

2.1 Proposal

The original 2-IMMERSE project proposal for *Theatre in Schools* is described below; this is an excerpt from an earlier deliverable, D4.1. A visualisation of the service is shown in Figure 1 .

This service innovation is called Theatre in Schools. This service enables pupils in schools across the country to watch a filmed performance of a play in a production by the Royal Shakespeare Company. Pupils are able to augment the main filmed presentation of a play with access to related supporting content and experiences to help them deepen their understanding of the play. This related content may include a synchronised transcript of the play, character summaries, short films featuring the talent in the play and even live communication session with the actors and other creative talent associated with the production.



Figure 1 Early visualisation of the *Theatre in Schools* experience

2.1.1 Social Context (excerpt from D4.1)

The Royal Shakespeare Company (RSC) a UK-based theatre company, were partners in the first 2-IMMERSE service trial, *Theatre at Home*. During 2017 this relationship continued during the early development work of *Theatre in Schools*. The social context within which the *Theatre in Schools* service trial was being developed was influenced by the RSCs rationale for their service offering to schools, which took the form of streams of recorded theatre productions. The RSC Education department wrote: “*The new curriculum for KeyStage3 means that students are required to study two Shakespeare plays; we know that one of the best ways to experience Shakespeare is to see it live [and we believe] our Schools' Broadcasts are transforming young people's attitudes towards Shakespeare.*”

The *Theatre in Schools* demo was intended to enhance this invaluable experience of seeing Shakespeare as-live and as a consequence deepen and enrich young people’s attitudes to Shakespeare and the other performing arts.

2.2 Background Research

During 2017 the 2-IMMERSE team carried out background research activities, to gather information to inform the design and development of the *Theatre in Schools* prototype and trial. In line with the 2-IMMERSE project goals, the aims included to:

- Identify the strengths, weaknesses and unique selling points of a 2-IMMERSE system in the classroom.
- Establish what 2-IMMERSE, and companion screen-based learning could bring to the classroom that current methods cannot (i.e., pen/paper, discussion, activities) or how a companion screen might enhance or add value to these established activities.
- Understand how teachers and students can benefit from the 2-IMMERSE experience.
- Enable the 2-IMMERSE team to design a user experience that nurtures collaboration between students.
- Understand how 2-IMMERSE could enable teachers to structure learning and undertake learning activities.



Figure 2 RSC Schools Broadcasts website, NT Live website.

The activities included observations of RSC Schools Broadcasts in schools, interviews with educators and students of English and Drama, a review of literature and materials currently on offer to schools (including other in-school providers such as National Theatre Live and BBC Bitesize) see Figure 2, and research on the orchestration and curation of shared media experiences.



Figure 3 RSC School Broadcasts (images supplied by RSC) showing different settings in which schools broadcasts are presented (blurry images ensure GDPR compliance).

Observations of in school broadcast highlighted among other things, the set ups that are used in school to watch the schools broadcasts. As can be seen in Figure 3, set ups in different schools vary; sometimes children were seated on the floor in a larger space like a hall looking a single projection screen, sometimes they were seated at tables in a classroom looking to a screen at the front of the class. We designed our service prototype with a traditional classroom set up (children around tables) – rather than for children collected in a hall.

The background research gave us an understanding of:

- Drivers and initial assumptions behind the *Theatre in Schools* service¹
- Literature on designing the user experience – future of learning, learning theories²
- Research on orchestration & curation of shared media experiences, devices and setup

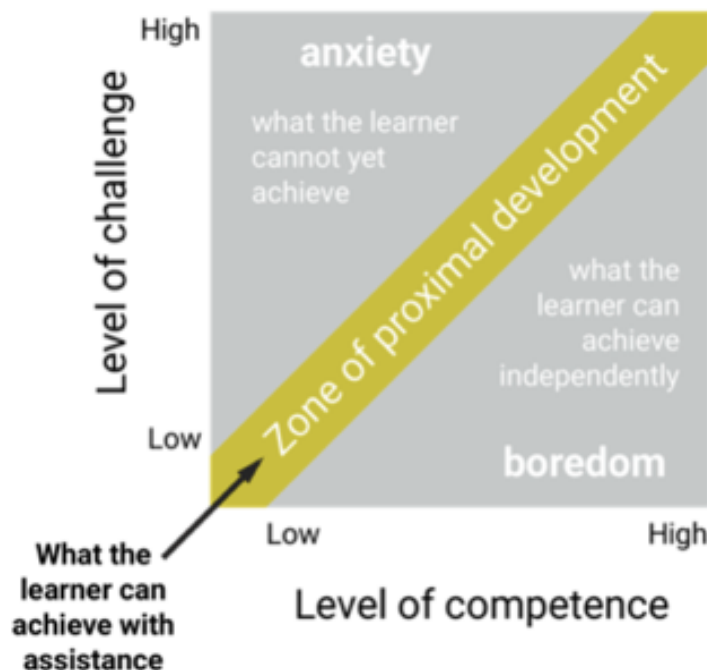


Figure 4 Zone of Proximal Development: nurturing and guiding to fulfill potential

Other insights gained in the background research phase included insights about the best ways of achieving learning goals. For example, the idea of a ‘Zone of Proximal Development’ (see Figure 4) was useful during the development of *Theatre in Schools* activities. This idea suggests that a learning experience should provide a level of challenge for the student and the right degree of independence to achieve learning goals. In line with this, aspects of the 2-IMMERSE activities were conceived to incorporate phases in which the student is supported, and phases when they work individually or in small groups away from the teacher.

Another useful example from Learning Theory is ‘Blooms Taxonomy’ (see Figure 5) which defines six levels of behaviours that are important in the learning process. It was important for 2-IMMERSE to consider how we might support this learning journey, so we incorporated elements within the activities, such as phases in which students would share and analyse, critique and review, and summarise understanding through annotation (their own creative input).

¹ NT LIVE: <https://schools.nationaltheatre.org.uk/app/os#!/home> , RSC: <https://www.rsc.org.uk/education/schools-broadcasts> ,

² ‘Trends in Learning Report 2017’ (Open University, Institute for Educational Technology), Bloom’s Taxonomy: about creativity as a starting point vs. rote learning , Zone of Proximal Development, Pyramid of participation

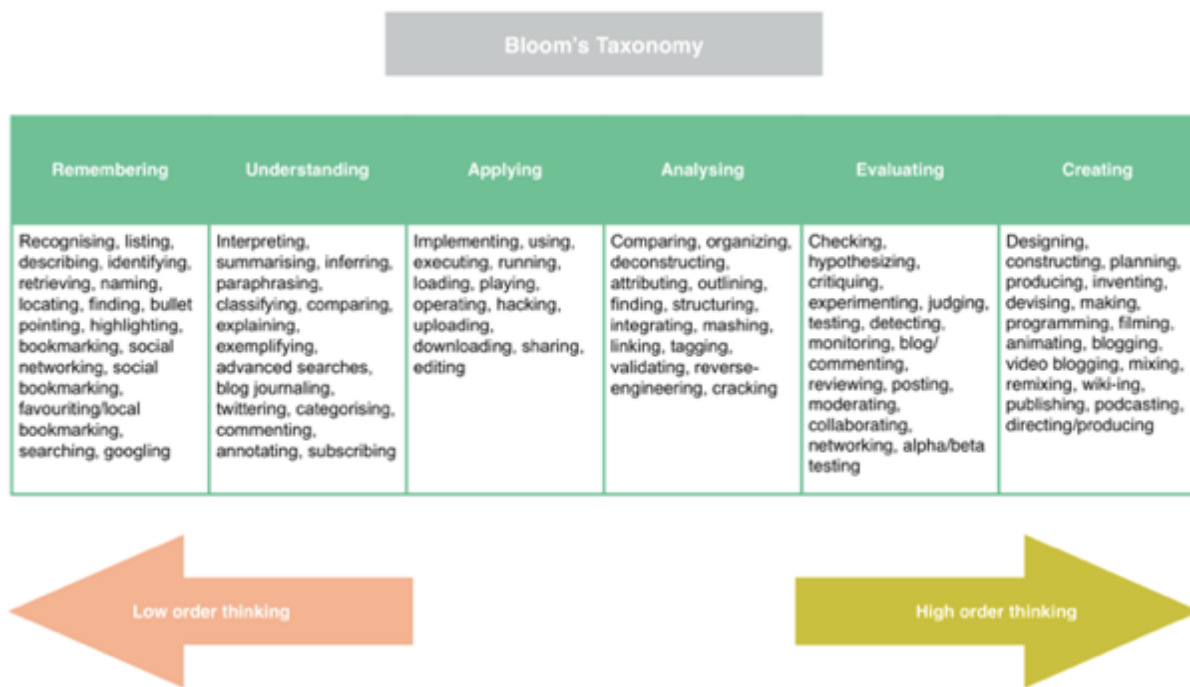


Figure 5 Bloom's Taxonomy: about creativity as a starting point vs. rote learning

2.2.1 Concept development

The background research, revealed a number of key findings for the project that were used in the development of concepts. These included that:

- there is a range of different set-ups for viewing in schools, from cushions in a hall, to chairs in classroom
- schools have different levels of access to technology; some schools have a tablet for each pupil, but it seems the majority have few if any tablet screens available to pupils
- teachers would like more control over the viewing experience and be able to pause
- after the live RSC Schools Broadcasts, there is a desire to re-visit the performance and Q&As

The findings were presented in ideation sessions, and a number of desirable *Theatre in Schools* concepts were identified:

- Instant feedback – such as a ‘feelings word cloud’ – ‘*how did you feel when Hamlet said that?*’
- Short quizzes & votes – ‘*Is Othello in trouble?*’, ‘*Is Hamlet mad?*’, with live aggregation across classes or even across multiple schools
- Connecting partner schools via live video for group Q&As (this was envisaged with teachers orchestrating sessions within each school, while one teacher chaired the session between schools)
- Replays, together with scenes offered as components
- Availability of a synopsis, together with commentary content
- Alerts/prompts/highlights - created by teachers in line with learning objectives – ‘*In this scene look out for Hamlet's conversation with...*’
- Tagging option - students to have access to a timeline of the play and have the option to ‘tag’ specific moments (either with an icon or comment) which they could then go back to when discussing the play with teachers or peers
- Help for teachers to design, distribute and track lesson plans

We followed a Google Sprint process, and turned relevant points into ‘How might we’ (HMWs) statements. The HMWs were used to create ideas, which we shared back, and turned into solution sketches.



Figure 6 Images from an ideation session at the BBC with 2-IMMERSE team members and students on placement to BBC R&D

Solution sketches were presented to members of the 2-IMMERSE project team for critique of the concepts in relation to technology, the aims of 2-IMMERSE and educational objectives.

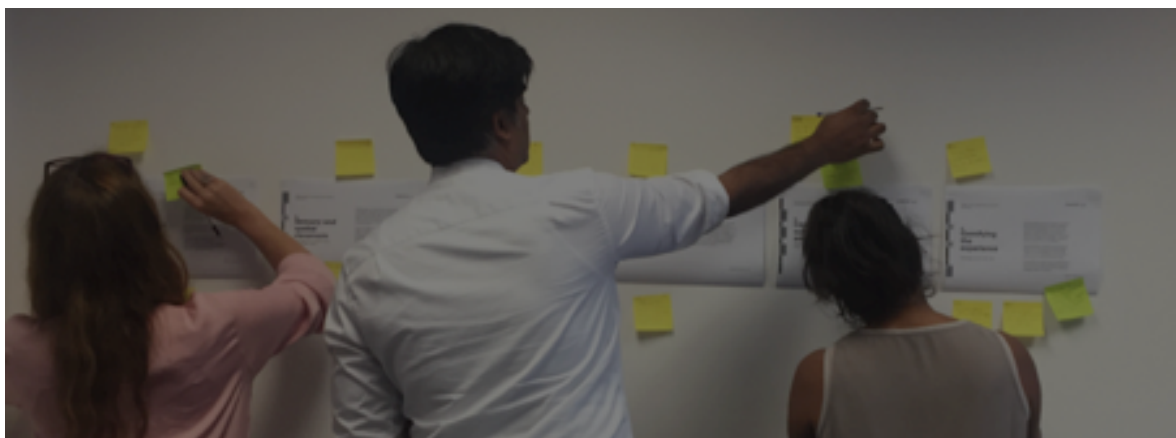


Figure 7 Image from a technical review: ideas from the ideation session were presented to members of the 2-IMMERSE development team and reviewed against 2-IMMERSE technical goals.

Following this session, the ideas were grouped into three tiers according to priority according to technological and editorial feasibility and appropriateness for a learning environment.

Key experiences were identified as:

- use of captions and scripts to dissect and perform key scenes
- exploring approaches to consider a variety of interpretations of the play
- teacher curation
- second screen remote control.

Nice to have experiences included the concept of an immersive theatre explorer using 360 video and augmented reality technology. Whilst it was thought this may enhance motivation, neither idea was ultimately realised.

2.3 Introducing Donmar Warehouse

The *Theatre at Home* prototype was developed with the RSC and 2-IMMERSE had originally envisaged a further partnership with the RSC for the *Theatre in Schools*. Although pleased with the work achieved with *Theatre at Home*, the RSC felt that it needed to devote the energy and resources of the Education department to other projects, including those that could contribute substantial sponsorship funds to the company.

The 2-IMMERSE partner Illuminations identified the Donmar Warehouse as an alternative collaborator, and in particular the innovative education initiative the theatre company planned alongside a filmed performance of William Shakespeare's *Julius Caesar*³. This film, together with two related films of *Henry IV* and *The Tempest*, was created quite separately from 2-IMMERSE with Illuminations. The three films were collectively titled the Shakespeare Trilogy.

The Donmar Warehouse (invariably known as just the Donmar) is an intimate 251-seat, subsidised theatre located in London's Covent Garden. It enjoys an international reputation as one of Britain's principal producing theatres, having won over 100 major awards during its 24-year history. The theatre's productions aim to be contemporary responses to the canon, to revivals of modern classics, and bold commissions of new work. As the company's website announces, 'we always prize diversity and freedom of expression, and with each new production we seek to innovate and spark debate.' Further, 'our exceptional education work empowers young people and cultivates a new generation of artists and audiences, while our creative development programme invites great theatre artists to push themselves and the boundaries of theatre-making.'

Several factors informed our decision to work with the Donmar, including:

- the extensive education initiative planned for *Julius Caesar* paralleled and complemented the aims of the *Theatre in Schools* planned prototype
- the schedule of the Donmar's education work matched almost precisely the ideal schedule for 2-IMMERSE's development of the prototype, and this offered more opportunities for the in-depth involvement of both teachers and students than would have been on offer from the RSC in this time period
- the broad range of additional video and audio assets already available
- the well-established relationship with the Donmar enjoyed by Illuminations. The excitement on the part of the Donmar about a collaboration with 2-IMMERSE. We understood that this would be valuable throughout the development, production, trials and evaluation phases the work, as well as for the dissemination of the 2-IMMERSE research.

The Donmar film of *Julius Caesar* was developed from a staging of the play by director Phyllida Lloyd. The stage production was played by an all-female cast and presented as if being put on in a women's prison. The staging attracted exceptional reviews in the autumn of 2016. Working with Illuminations, Phyllida Lloyd filmed the show in the theatre but then oversaw an extensive post-production period of editing and sound mixing to transform the multi-camera recording into a distinctive and innovative screen adaptation.

The Donmar stage production was intended especially to attract young audiences who rarely go to the theatre. Moreover, the Donmar planned from the start of the project to create an extensive educational programme alongside the presentation of the film in schools (and also in prisons, although this is out-of-scope for 2-IMMERSE). As a consequence, interviews, workshop documentation, behind-the-scenes recordings and other video assets were gathered throughout the five year period from the first rehearsals to the completion of the film, and these were all available for integration into the *Theatre in Schools* prototype.

During the summer of 2017 2-IMMERSE members met with the executive, operational, education and development departments at the Donmar to work out the framework of the collaboration. In parallel a detailed scoping of the possibilities for the *Theatre in Schools* prototype was undertaken.

In October 2017 the Donmar organised with two London schools a six-week series of workshops, see Figure 8, to explore and refine their education project, which was launched in June 2018. 2-IMMERSE project members were invited to observe these workshops, and this process is detailed in the next section.

³ The Donmar Trilogy website: <https://shakespeare-trilogy.donmarwarehouse.com>

2.3.1 Workshops with the Donmar Education Team in Schools

Through the workshops, schools created and explored the use of digital assets that could accompany the trilogy of films, when they were released to schools.



Figure 8 The Donmar education team introduce the presentations from two participating schools, the culmination of 6 weeks of workshops.

The aim of the workshops was to create and design a performance, using materials created during the workshops, which was influenced by the Donmar's *Julius Caesar* film.

Students took part in a variety of structured activities during the workshops:

- Understanding narrative of *Julius Caesar*
- Creating a visual synopsis
- Developing choreography

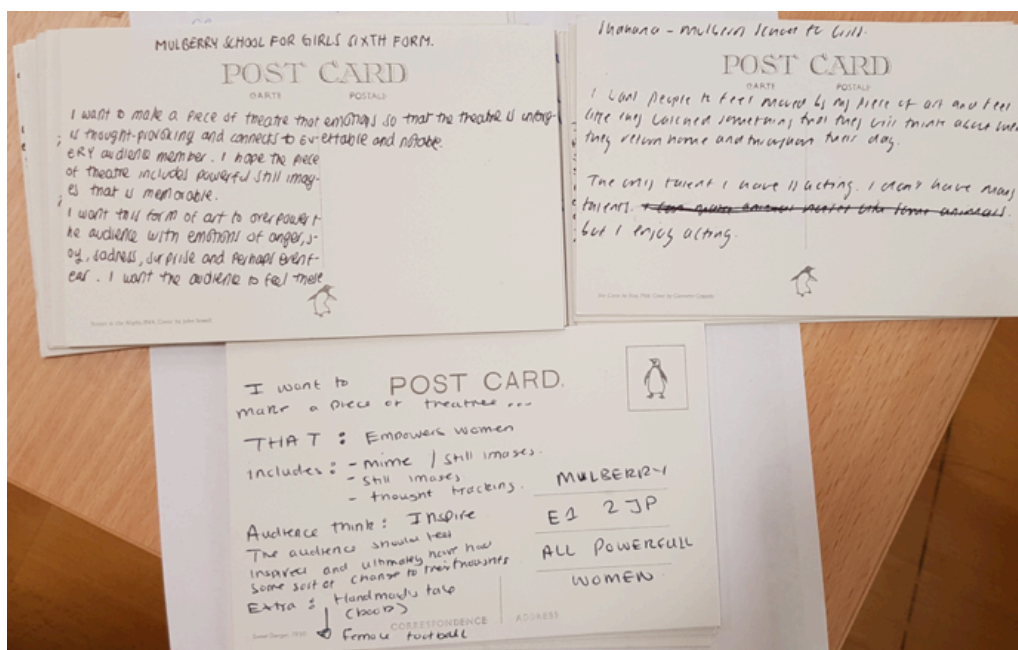


Figure 9 Examples of the postcards on which students completed the sentence 'I want to make a piece of theatre that....'

Students were also set some ‘homework activities’ that they completed between workshops, such as making Youtube videos of their ideas for the performance, or responding to questions set by the Donmar on postcards (see Figure 9).

The workshops were also linked to wider learning themes, such as Empowering the Female Voice, across the curriculum, covering not only Drama but also English and PSHE subjects in a holistic approach to learning, with the performance at the centre.

For example, an activity related to wider learning outcomes was a ‘Leading and Following’ exercise, in which students paired-up and took the role of ‘leader’ or ‘follower’ in a physical activity that made the feelings of power and responsibility tangible;

In Free-writing exercises, students began to enjoy language, and created materials that could become a script for their final performance and/or be used as stimulus material during the workshop. For example, students were given a series of sentences to complete at two-minute intervals that started with: *Women can...; Women can’t...; My gender...; I am...; I fight....*”

During this exercise, ambient music was played in the background to break the silence of the room and students were encouraged to write continually, facilitators said “*If you can’t think of anything, just write ‘I am writing’ until the words start flowing again.*”



Figure 10 Concept illustrating how multiple screens could be used to view the synchronized perspectives of different characters

2.3.2 Aligning the aims of 2-IMMERSE and the Donmar

The workshops enabled the 2-IMMERSE project team to align the aims of the project with the interests of the Donmar. The following principles were agreed:

- Aim for features grounded in an extended viewing of the film
- Build on the approach of using the recording and related materials to stimulate and inform a range of activities
- Offer support for the ‘holistic approach’ for cross-curriculum subjects (Drama, English, PSHE ie Personal, social and health education) for students’ growth and development
- Showcase a range of set-ups and scenarios
- Intend that, through the *Theatre in Schools* experience, the film and the digital assets provided could give a young person a way of ‘seeing’ which could only be done through a production

(live or DVD) and workshop with the Donmar; this would permit equal provision for schools who cannot have an educational practitioner or artist in the room.

- Enhance the experience by allowing access to assets and support not possible through the production (live or *via* DVD) and a workshop alone, so giving a young person a way of ‘seeing’ that which could not have been done before.

The project explored these ideas and developed a number of images that acted as An exploration of concepts that would illustrate these principles was made, and three potential scenarios emerged, which formed stimulus material for the 2-IMMERSE project team. These are shown below. In Figure 10 we illustrate how the play could be presented differently using multiple screens. This layout idea was borrowed from some concepts developed in the *Football FanZone* work. Although multiple camera views had been recorded, on review, the footage was not complete enough to offer this scenario. We were committed to delivery over multiple screens and ultimately settled on using one main shared presentation screen and student tablets and teacher tablets as the additional screens.

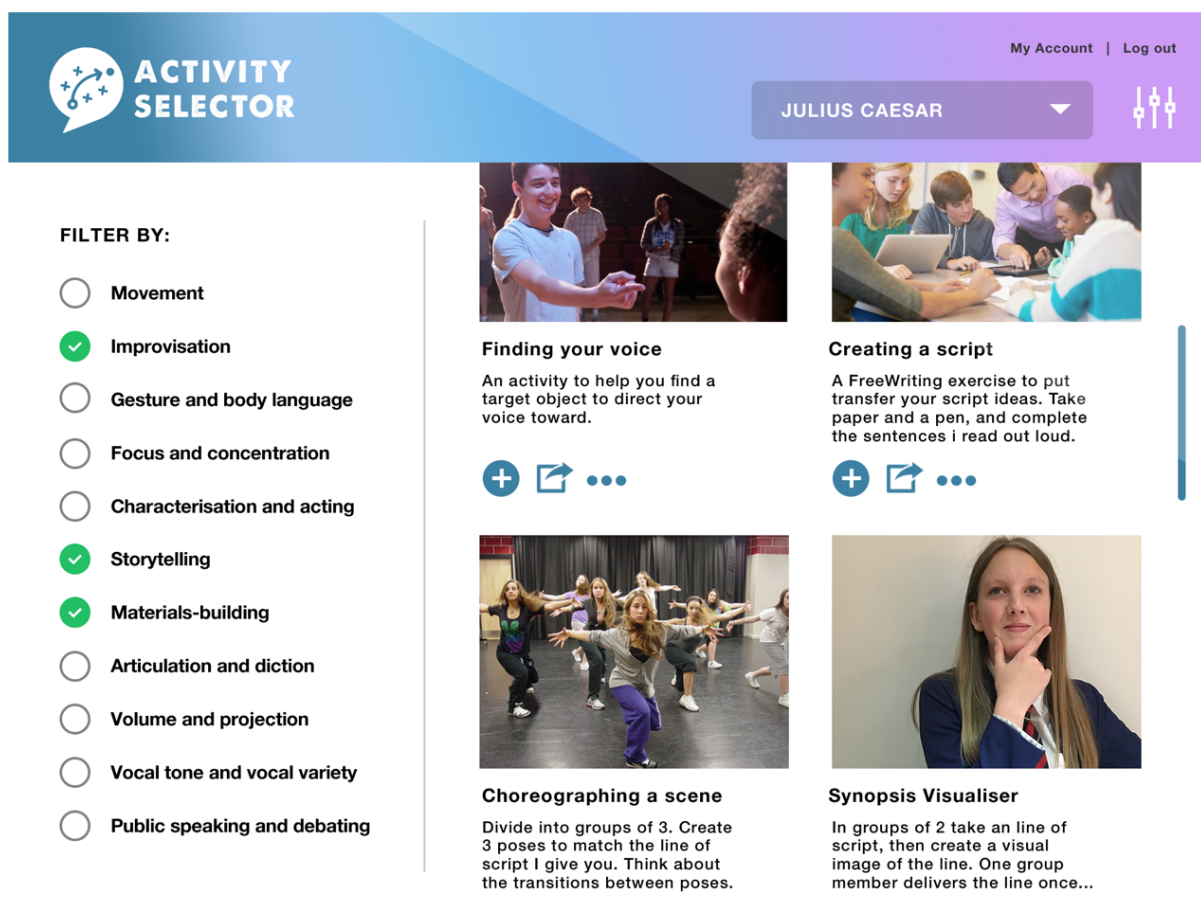


Figure 11 Concept illustration of an ‘Activity Selector’ for teachers. This concept shows how teachers could discover resources developed by Donmar to achieve certain learning goals.

In Figure 11 we illustrate a screen that could form part of the ‘end game’, should the *Theatre in Schools* approach be commercialised and scaled up to address all the content The Donmar have created. The Donmar Warehouse have developed a wide array of digital resources and lesson plans addressing different learning outcomes. What we try and illustrate here through the Activity Selector shown in Figure 11, is the way that all of these resources could be indexed and filtered so that teachers could find resources that would help them teach to learning goals they specify. This might help teachers identify resources and lessons better suited to a particular subject (Drama, English, PSHE - Personal, social and health education).



Figure 12 The 'Synopsis Builder' concept is based on an activity in which students capture a physical pose to illustrate key plot-points (to develop choreography ideas, and to internalise the lines and plot).

The third example we show here is the synopsis builder which is illustrated in Figure 12 and Figure 13. The concept is derived from an exercise run in person by the Donmar in which students are invited to strike a pose to illustrate what they consider to be the key plot points of the story; in so doing students have to show an understanding of the whole story and to identify and then represent the drama that exists at each point. The lessons we chose to develop were focused on English more than Drama so the concept was developed away from the need to strike pose and morphed into the need to retell the story again by identifying and then adding commentary to, the key plot points. This was the basis of the StoryBuilder concept that emerged as one of the three lesson ideas.

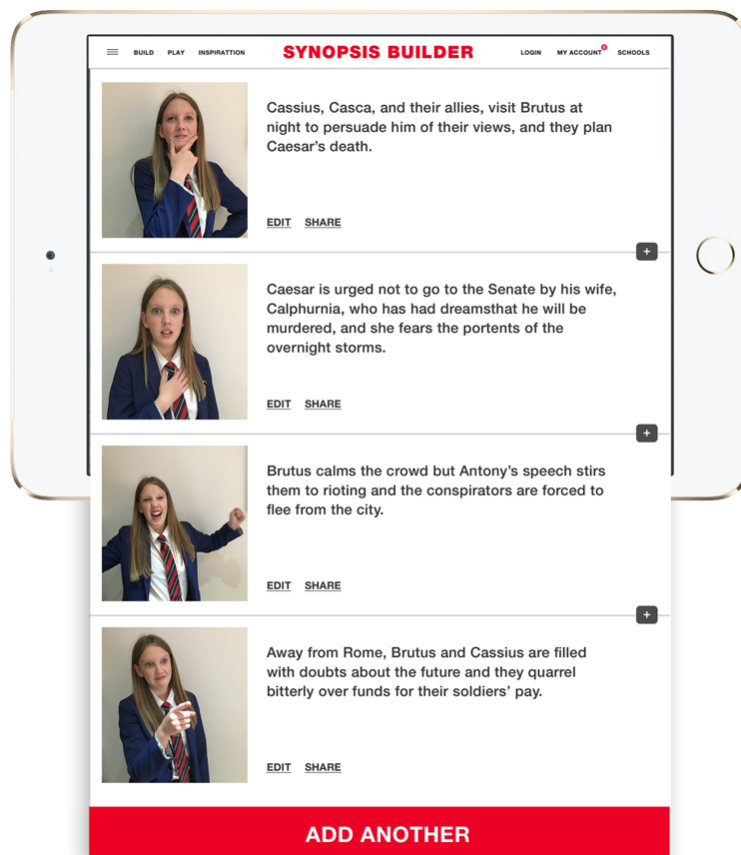


Figure 13 A conceptual illustration of The Synopsis Builder playlist (later to be the StoryBuilder), which students share with peers to illustrate their 'key plot points' from the synopsis.

2.4 Developing the *Theatre in Schools* Prototype

The design process was guided by the hierarchical set of principles outlined in section 6.3. As noted above, to accompany the Trilogy films, the Donmar Education team produced a set of learning resources for schools including videos and guided learning exercises. These can be found from the Donmar web site, see Figure 14.

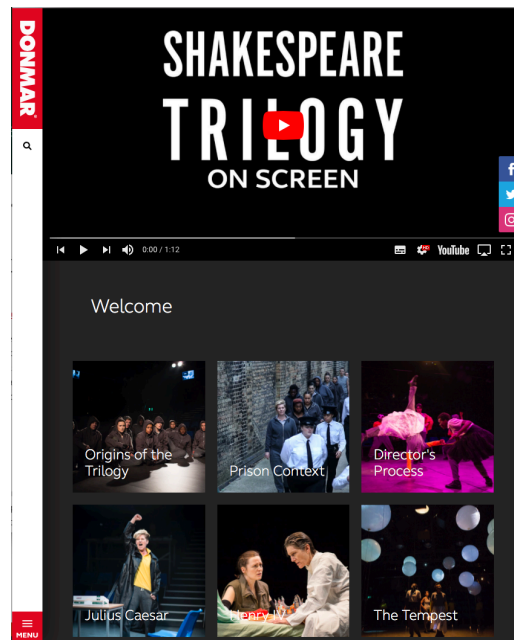


Figure 14 Donmar Warehouse - Shakespeare Trilogy website

The exercises are aimed at Drama and English curricula in Key Stages 3-5 – see Table 1 for an explanation of UK education system Key Stages.

Key Stage	School setting	School year	Age at year intake	Exam
Key Stage 1	Primary school	Years 1-3	5-7	
Key Stage 2	Primary school	years 4-6	8-10	
Key Stage 3	Secondary school	years, 7-9	11-13	
Key Stage 4	Secondary school	years 10-11	14-15	GCSEs
Key Stage 5	Secondary school/college	aged 12-13	16-17	A-levels

Table 1 The UK education system is organised against Key Stages – this table enables the reader to translate between key stage and school year or age.

The 2-IMMERSE UX-design team, informed by the background research outlined in the previous sections, adapted three of the exercises developed by the Donmar based on the film of *Julius Caesar*, exploring plot, rhetoric and characters into sample interactive learning modules for a multi-screen environment. The first two of these three exercises were developed and built, and are active in the final version of the *Theatre in Schools* prototype; time and resource constraints prevented the full realisation of the third.

The following sections describe the features and components for the *Theatre in Schools* prototype. The description includes the design criteria for the prototype; the prototype challenge, goals and main design principles. The Donmar Shakespeare Trilogy web resources are introduced, including an outline of the *Julius Caesar* content used within the prototype. The prototype framework is described,

including the concept of adaptable learning modules and a structure for participation for teachers and students. A list of the supporting 2-IMMERSE facilities is included.

2.4.1 Process

Working with the Donmar has involved a number of key activities.

- Defining a design brief and agreeing common goals for the prototype
- Undertaking further digital design research and sharing this with the Donmar team
- Defining a concept based around a flexible lesson structure and learning modules
- Creating a set of scenarios to visualise the proposition
- Reviewing the Donmar's Trilogy content and agreeing prototype content.
- Reviewing prototype wireframes
- Adapting the Donmar and Trilogy website brands (see Figure 18) for the prototype
- Reviewing the prototype and providing feedback on the system
- Planning, designing and running the trials within schools

In parallel to these activities were technical reviews of the prototype proposition to map against current capabilities in the platform, to define and shape new capabilities and to ensure that the prototype met the technical requirements of the project.

2.5 Design Criteria

In this section we document some of the design thinking relevant to the development of the *Theatre in Schools* service prototype. The design was constrained by principles (more of these in section 6.3) including principles derived from:

- the scope and resource of the project
- the goals of the producer, Donmar Warehouse
- the requirements of the teacher
- the requirements of the end users- the pupils
- the wider cannon of good UX-principles.

The Donmar provide excellent education resources but currently the best experience of these resources is when delivered using facilitators familiar with the Donmar Warehouse material. This is very difficult to scale and particularly difficult to deliver to schools and audiences that are a long way from the Donmar's London base. Donmar Warehouse wanted to enable equal access to their resources regardless of location, using multiple connected screens.

The 2-IMMERSE goal was to demonstrate that working with multiple screens has the potential to achieve learning goals more effectively than a single screen alternative.

Through the prototype the project goals were to test and evaluate:

- learning on multiple screens with different content types
- ways in which this may function effectively in schools
- opportunities for a scalable platform and service

The 2-IMMERSE and the Donmar teams collaborated to:

- inform the design of the prototype
- adapt learning materials and content for the prototype
- plan evaluation of the prototype in school settings

2.6 Goals

A set of goals emerged that are closely linked to the design principle discussed earlier.

1. For the Technology Provider (2-IMMERSE) to deliver personalised experiences using:
 - a. Synchronise media objects in multi-screen presentations

-
- b. Personalise views to different skills and roles
 - c. Enable students and teachers to interact with tablets tailored to their role
 - d. Enable users to view and review content on shared displays
 2. For the Producer (Donmar Warehouse) to illustrate how the Donmar's resources could:
 - a. Extend the reach of learning materials to more schools by providing support and tools when the educational facilitator or artist is not present
 - b. Bring together Shakespeare's text, the production, learning activities, resources, and user annotations as part of a coherent live lesson
 3. For the Director of the experience (the Teacher), to offer a flexible framework that would allow lessons to be adapted, enhanced and extended to:
 - a. Support teachers with mentoring and co-ordination
 - b. Provide a set of modules with different content and exercises which can be adapted for duration, for the knowledge of the students and the availability of technology
 4. For the learner (the Student), to offer activities that:
 - a. Support measurable learner outcomes
 - b. Are engaging for young learners, involving them in the process
 - c. Give students the opportunity to work together to share and discuss the themes, and their work, within groups and as a class

3 Concept development - Overview

In this section we illustrate how the concept used in the theatre In Schools service prototype were developed. The approach includes looking at the opportunity through a number of different lenses including the nature of a lesson, the affordances of the technology and typical learning activities we might expect to young learners to complete. These are discussed further in the following sections.

The design stages that allowed us to address the issue through the different ‘lenses’ included:

- Research and initial concept development
- Scenario development including preliminary visualisations
- Content creation and brand development
- Wireframes and technical design documents
- Prototype development and iterative testing
- User studies, including interviews and field trials

In the following sections we highlight some of the key findings.

3.1 Lesson structure

A key frame for the concept must be a lesson, a period typically between 45 and 90 minutes long. We recognised that a lesson was a live structured experience orchestrated by the teacher.

Based on our observations of the Donmar workshops we mapped traditional group exercises onto a sample lesson timeline to inform how we might create different interaction modes for multiple screens and users within the prototype.

In the Donmar workshops we noted the following structure for the lessons:

- Watch (eyes front). The educator gathers the class together and explains a concept or activity
- Make (activity). The class works on the same activity or parts of an activity in groups or pairs.
- Share. The groups come together and share their activity and discuss what they have learnt.

We used this structure (as illustrated in Figure 15) as a common framework for our lessons and labelled it Watch / Make / Share in the final prototype.

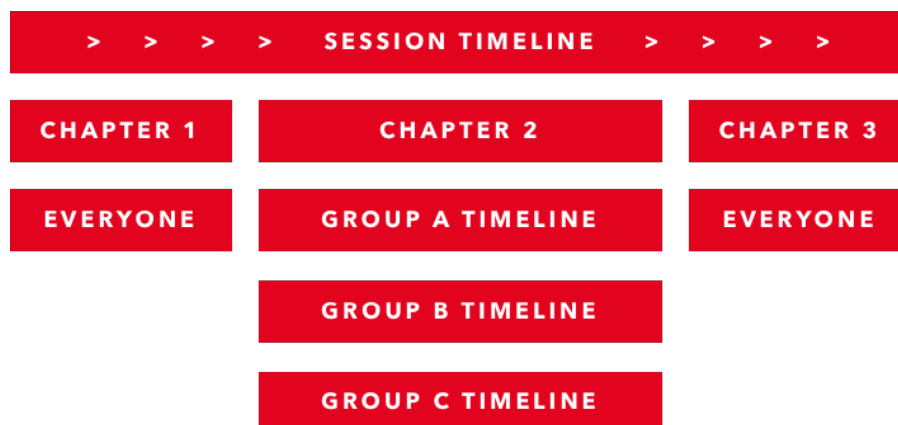


Figure 15 Lesson Timeline – Chapters

In the final version of the prototype the teacher is in full control of the timeline, co-ordinates the class activity and the multiple screens in the lesson; the shared display, multiple student companion screens and the teacher companion screen. The teacher companion screen is able to control all aspects of the lesson, including when all devices are synchronised as a class and when group work will take place. These chapters thus form part of a learning module, which could support different learning goals.

3.2 Affordances of technical capabilities

We conducted further desk-based research to develop the concept. We reviewed the capabilities of the 2-IMMERSE *MotoGP* prototype and considered how the capabilities could be used in a classroom setting with groups of students and a teacher directing activity. The outcome of this analysis, illustrating how the capabilities can be re-used between highly diverse experiences is illustrated in Table 2 Showing how capabilities developed for *MotoGP* can be appropriated for use in the *Theatre in Schools* service prototype.

Layers in <i>MotoGP</i>	Layers in <i>Theatre in Schools</i>
Panels with live data Cast to the screen (Picture in Picture) Show/Hide elements	Annotations, subtitles Live Responses Aggregated results Icons and Indicators
Timeline in <i>MotoGP</i>	Timeline in <i>Theatre in Schools</i>
Show/hide events Mark up events Play events	Change sequence of events, playlist Multiple timelines Bookmark events Interactive timeline
Personalisation in <i>MotoGP</i>	Personalisation in <i>Theatre in Schools</i>
Adaptive screen presentation Skills view - novice, expert Selecting cameras, highlights, casting highlights	Themes – Power, persuasion, politics Key Stages – student age Curriculum – English, Drama, PSHE Role and mode – teacher, student
Multi-screen in <i>MotoGP</i>	Multi-screen in <i>Theatre in Schools</i>
Synch all the screens to show same thing Synch content on tablets with video on main screen Select content on tablets to show on main screen	Know status of each device, is it active? Attention control A social experience with group interactions Turn by turn, aggregated content

Table 2 Showing how capabilities developed for *MotoGP* can be appropriated for use in the *Theatre in Schools* service prototype.

3.3 Potential student activities

We reviewed the types of interactions and activities the students undertook in The Donmar Workshops. We supplemented these observations with desk-based research on web-based downloadable learning resources from the BBC and the RSC. We categorised different types of activities within these resources into two types: Performance Delivery and Investigation and Discovery. This analysis is illustrated in Table 3.

Performance and Delivery	Investigation and Discovery
Freeze frames Tableaux Perform extracts Say lines in groups	Play detective Create storyboards Highlight important things Quizzes

Table 3 Activity types identified in lesson from existing on line resources

3.4 Lesson ideas - long list

We developed a set of sixteen possible lesson activities based on particular capabilities of the platform and, see the first column of Table 4. In the concept, the teacher would be able to choose from a selection of the lesson activity ideas for their lesson topic. In Table 4 we list scenario ideas (right hand column) that could use the different lesson activities.

Capability + lesson activity ideas	Possible scenario ideas
Bookmarking and Replay	Make Your Mark
Investigating scenes Creating playlists Making annotations	Identify key themes in a video Select icons from a palette or menu Pause and replay video and mark up video Use up all the icons to complete the task Progress is show on shared screen Scoring and competition
Story and Sequencing	Unscramble
Working with story fragments Playing back new sequences Time limitations	Watch video play out in introduction Given a storyboard out of order Put the storyboard in a sequence Each storyboard can then play out on the screen Each group has different storyboard The whole story plays out in order team by team
Feedback and Responses	Word Search
Visual overlays Class responses Synchronised feedback and results	Performance plays out on shared screen Students to search for key power words Students highlight power words on script Word bubbles appear in layers over the video Move onto another type of phrase or word Playback and discuss
Performing and Remixing	Ad Lib
Audio control Video fragments Timing and playback Playful interaction	Student see a shared performance with subtitles Mute character(s) Students say lines in turn or together Pop instructions to change emphasis on line Pop instructions to change timing on lines Students write own variations of lines

Table 4 Sets of concepts (scenarios) afforded by the capabilities of the platform that could be used in lessons.

3.5 Scenario Development

We reviewed these observations (section 3.1 to 3.4) with the Donmar Education team. It was agreed that the notion of a timeline (Watch / Make / Share) to provide a framework upon which to build a series of learning modules (activities) was a good way to develop the *Theatre in Schools* experience.

The *MotoGP* application was also demonstrated to the Donmar Education team, so they could have a greater understanding of the multi-screen capabilities of the platform and experience.

Using draft learning content from the Donmar team, we were able to develop more specific scenarios to visualise the concept. Our first set of proposed modules in the scenarios were Plot, Script and Movement.

Within these scenarios we envisaged allocating students to teams and sharing their progress completing tasks on the main screen.

The Donmar team advised that we should focus more on co-operation and discussion within the tasks and to support groups who completed tasks at different speeds. We represented this concept as shown in Figure 16, with the teacher companion screen shown in the bottom right.

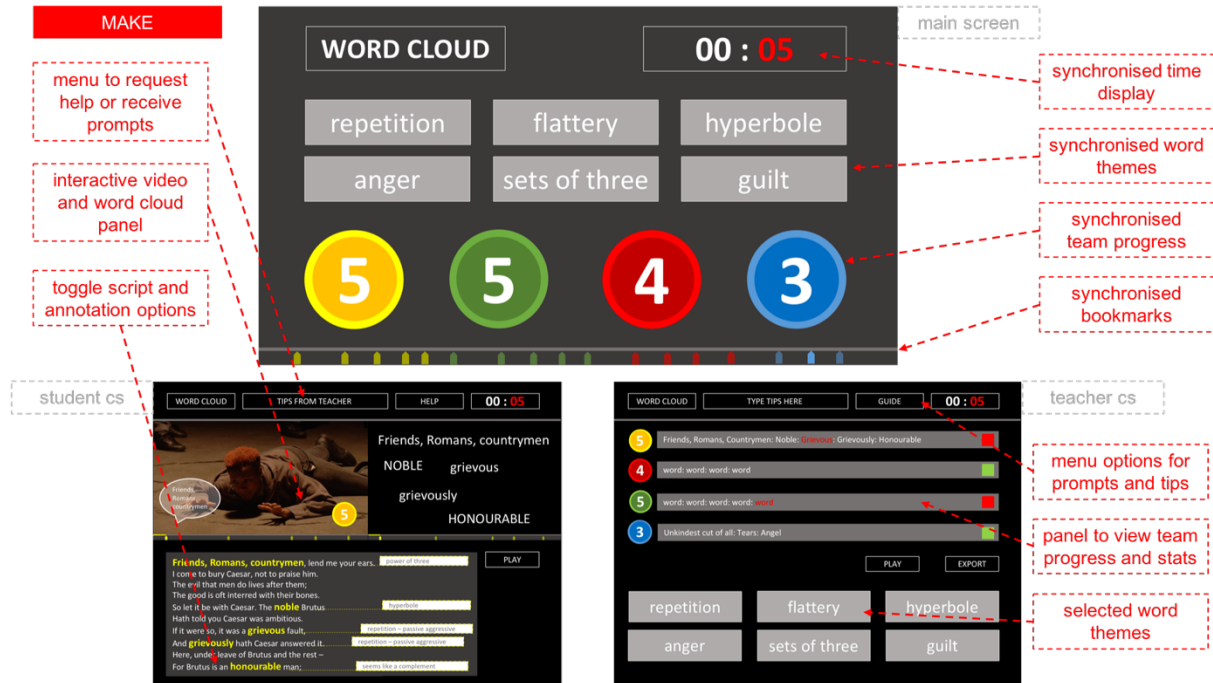


Figure 16 Early Scenario Development – Team Activity

With this in mind we changed the emphasis to student groups and the task progress view became a resource for the teacher as an aid to help and support students.

We reviewed the finalised Trilogy *Julius Caesar* learning exercises and video resources and agreed to develop a first set of full scenarios for Plot, Script and Character modules. From these we could produce more advanced wireframes and define the capabilities and the flexible framework to support the module features and adapt the learning content.

3.6 Technical requirements

A set of key capabilities were identified for the modules and visualised in the scenarios. Existing capabilities from previous 2-IMMERSE service trials (e.g., *Theatre at Home*, *MotoGP*, *Football Fanzone*) included:

- Object based graphics and audio:
 - Content mark-up and display rules
- Synchronised content:
 - Video, graphics, audio, data
- Multi-screen experience:
 - Shared display and multiple tablets

A number of new capabilities, specific for the *Theatre in Schools* service trial demo were also identified:

- Content Browser
 - Interactive interface to combine D-Mapp components
 - Personalised browser interface for teacher and students
- Bookmark timeline
 - Non-linear control of the timeline, play, pause and bookmark selection
 - Bookmarked video playlists created from content selection
- User Annotation
 - Annotation of video playlist elements and display
 - Aggregated annotation and display
- Aggregated Live Interactions and Inputs
 - Voting functionality
 - Teacher view of student interactions in activities
- Audio Management
 - Companion screens automatically set to mute when video on shared display
 - Local control on audio when in make activity
- Orchestration of User Attention
 - Handover between teacher and student devices for shared display control
 - Teacher controls student screen displays in all modes
- Branching timeline
 - The lesson timeline branches in each of the Watch / Make / Share sections
 - Data created in Make is aggregated for share mode

3.7 The ‘Watch / Make / Share’ framework

Our project adapted three exercises into sample interactive learning modules for a multi-screen environment. As described above we agreed to adopt a common structure Watch / Make / Share for the overall lesson structure: Within each section only certain activities can take place:

1. Watch:
 - a. The teacher shares video interviews with the cast to introduce themes and provide insights into the play.
 - b. The teacher can also run an interactive vote.
2. Make:
 - a. Students work in small groups on an exercise which uses the script and video clips from the production.
 - b. Students are able to add their annotations which will be displayed in share.
3. Share:
 - a. The teacher brings the students back together to share their work and discuss the process, outcomes and themes.
 - b. The teacher can offer screen controls to the students.

3.8 Achieving flexibility using the framework

The overall Watch / Make / Share framework is common but it is not rigid. Teachers were able to adapt the timing and some of the content to fit within their lesson schedule and curriculum. The teacher also controls the displays, guides students, co-ordinates the learning activities and leads the discussion. The ways in which flexibility can be achieved within this framework are detailed below

3.8.1 Flexibility with regards to the overall timing

A module runs within the timeframe of the lesson but teachers can adjust the length of each part of the Watch / Make / Share framework.

3.8.2 Flexibility within the Watch section

Given the availability of play and pause features and the ability to select bookmarked discussion points, the teacher has a lot of flexibility into what is discussed and about how long the discussion continues for. Also, due to the control that can be exerted through the teachers tablet, the teacher can decide what students see on their screens and when

3.8.3 Flexibility within the Make section

The teacher can decide how the lesson is structured, the lesson was designed to support group work but teachers could, if there were sufficient tablets, choose for students to work on their own. Further the teacher can decide whether they want individuals/groups to work on all or just parts of the exercise

3.8.4 Flexibility within the Share section

During the share stage teacher again have flexibility; they can ask all or just some groups to share and they can ask groups to share all or just some of their work. During this stage the teacher can also add their own discussion points in response to the contributions of the students.

3.9 Lesson topics and structure

Three lessons were identified that could be developed within the project. These were:

- *Story builder*, in which students were asked to identify key plot points and to re tell the story using the key plot points they had chosen.
- *Script detective*, in which the use of rhetorical devices within a key speech was analysed
- *Profile creator*, in which students are encouraged to examine and describe key characters using clips and creative writing

The way the Watch / Make / Share structure was applied to these three lessons is described below. Using these modules, on tablets and shared displays, students are able to explore the way in which Shakespeare develops plot, uses language and develops character.

1. Story Builder:
 - a. The cast introduce the plot points in *Julius Caesar*
 - b. Students create a story playlist from plot points, production clips and add their own script annotations
 - c. The class share their stories as a group and discuss
2. Script Detective:
 - a. The cast introduce Mark Antony's funeral speech
 - b. Students review script segments and production clips and annotate these with keywords and emotions
 - c. The class see the complete funeral speech with their annotations
3. Profile Creator (which ultimately remained unrealised):
 - a. The cast introduce their characters, Brutus and Caesar
 - b. Students build a profile of Brutus or Caesar, using production clips and a creative writing exercise
 - c. The class share their profiles as a group and discuss

We identified assets for each module including; learning exercises and objectives, video cast interviews, the video production of *Julius Caesar*, and reference material. We also identified requirements for new assets for each module and authored these for each case.

1. General content:
 - a. Authoring synchronised prompts for all key stages in the module
 - b. Authoring a guide to the module and key stages with text and graphics
 - c. Authoring a guide to the Make activity
 - d. Re-purposing module specific reference content developed by the Donmar
2. Watch:
 - a. Identifying and marking up the cast interview videos.
 - b. Identifying timecodes in the video to create bookmarks for key learning points.
 - c. Sourcing stills and authoring learning points to synchronise with the video.
 - d. Authoring a sample vote question
3. Make
 - a. Re-purposing the Donmar Warehouse exercise content for the module exercise.
 - b. Identifying timecodes within the main production of *Julius Caesar* to use within the module as bookmarks and playlists
 - c. Linking text content with each potential bookmark/playlist
 - d. Authoring guides for the teacher to present to the class about the task
4. Share
 - a. Prompts and instructions for sharing the synchronised presentation

4 Story Builder - Prototype Service Descriptions

We created a set of non-branded wireframes for the three modules to establish common interface features and components. We prioritised the order of development, beginning with Story Builder, then Script Detective and finally Profile Creator.

For the final prototype we built and tested the Story Builder and Script Detective modules. These modules demonstrate: common capabilities, flexibility of the framework, different learning content and supporting material, and more complex Make and Share capabilities.

The Story Builder lesson is designed to help students learn and better understand the plot of the play *Julius Caesar*. In the following sections that Story Builder lesson is described in more detail.

4.1 Story Builder - Learning objectives

The learning objective is to support a deeper understanding of the plot of *Julius Caesar*. The Key learning goals are for students to be able to:

- Recount key plot points in the *Julius Caesar* story
- Describe some of the characters and their motivations in *Julius Caesar*
- Support each other as a team to tell the story.

4.2 Story Builder - Source material

The source material for the content of this module include:

1. Video
 - a. *Julius Caesar Plot*
 - i. A 2 minute 31 seconds video introduction to the plot of *Julius Caesar*
 - ii. 12 bookmark sections marked up in the video
 - iii. Each bookmark labelled with a theme identifier
 - b. *Julius Caesar* production
 - i. 19 virtual plot clips bookmarked in the complete filmed production
 - ii. Each plot clip linked to a selectable text plot point
2. Learning Content
 - c. 19 plot points
 - b. 19 character quotes, one for each plot point
 - c. A 12 point graphical story synopsis based on the *Julius Caesar Plot Video*
 - d. A visual character family tree featuring photographs of the cast in character
 - e. 12 stills from the production and text plot points
3. The Donmar Learning Resource (Available to registered account holders from the web site of the Donmar Warehouse (www.donmarewarehouse.com)
 - a. 128 - *Julius Caesar Plot Points*
 - b. 129 - *Julius Caesar Telling the Story*
 - c. 203 - *Julius Caesar Character Descriptions*

4.3 Story Builder - Common features across the lessons

As well as sharing a common structure (Watch / Make / Share) there are some common features of the prototype modules which include the on-boarding process, the screen configuration, and persistent tablet interface features.

The 2-IMMERSE on-boarding process connects the shared display and enables the selection of two user types; Teacher and Student. To connect a device as the Teacher companion screen, the Teacher profile is selected. From here the teacher can start the module and run the lesson. Student companion

screens connect via the student profile. Each Student device is allocated a group identifier automatically. Each group selects ready and the Teacher starts the session.

There are three types of screen within the prototype as shown in Figure 17.

1. Shared Display
 - a. A TV, smart display or projector and speakers
 - b. Controlled by the teacher in Watch and Make
 - c. Supervised control by the students in Share
 - d. Displays synchronised video, data overlays and digital media
2. Teacher Companion Screen
 - a. A tablet (Samsung s2, Google Pixel)
 - b. Teacher uses the tablet to manage the lesson
 - c. Manages activities, displays and digital media
3. Student Companion Screens
 - a. Tablets (Samsung s2, Google Pixel) – one tablet per group of 3 students
 - b. Students watch synchronised content
 - c. Take part in activities and share outcomes when directed

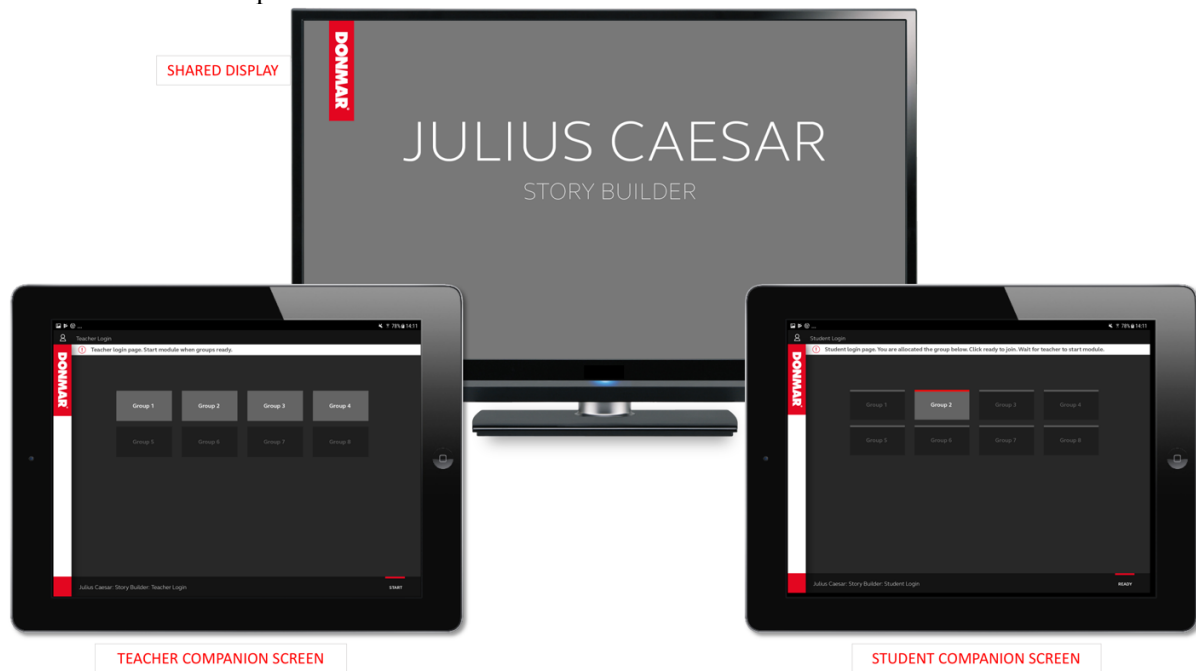


Figure 17 Showing examples of the three screen types, the shared display, the teacher tablet and the student tablet.

In addition to the features listed above the user interface uses elements of the Donmar Trilogy website brand across all lessons. Teacher and Students have the same interface layout but the content within the main panel is role specific and changes in response to the activity context. The user interface elements for the tablet are shown in Figure 18.

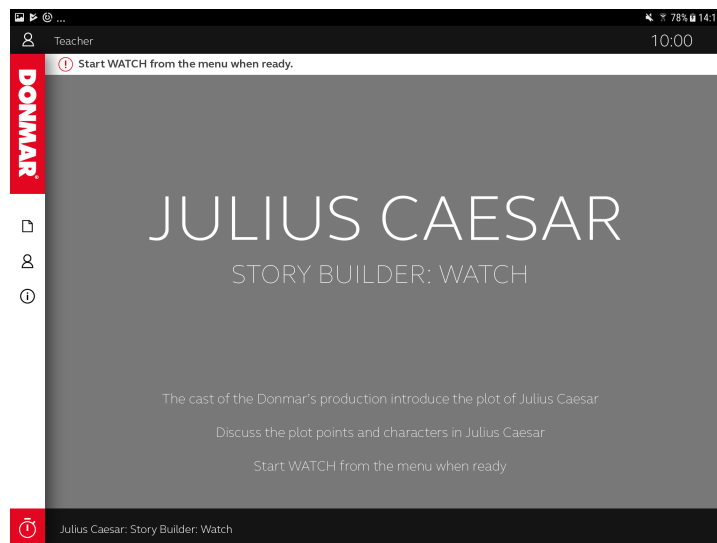


Figure 18 Tablet Interface - Layout, illustrating the status bar, left menu and main panel

They user interface elements include:

1. Status Bar
 - a. At the top of the screen
 - b. User logon details
 - c. Synchronised module timer
2. Left Menu
 - a. Donmar Logo
 - b. Icons for selection of different reference material
 - c. Lesson Timeline icon to select Watch / Make / Share modes
3. Main Panel
 - a. A prompt bar for synchronised prompts
 - b. Central panel for main content and contextual menus and interactions
 - c. Mode bar which indicates play title, module and mode status

4.4 Story Builder - Lesson timeline

The teacher initiates different parts of the module using the Lesson Timeline Icon (clock) at the bottom of the left panel Figure 18. The menu uses radio buttons, so only one selection can be made. Students can access the same timeline menu, but in display mode only. The panel is closed by clicking anywhere else on the screen or clicking the icon. The lesson time line panel is shown in Figure 19

1. The teacher can select the Watch / Make / Share options to start each task immediately
 - a. Start Watch
 - b. Start Make
 - c. Start Share
2. The teacher can share introduction and end screens between modes
 - a. Intro – displays contextual text about the objectives for the activity
 - b. End – displays contextual text summarising the activity.

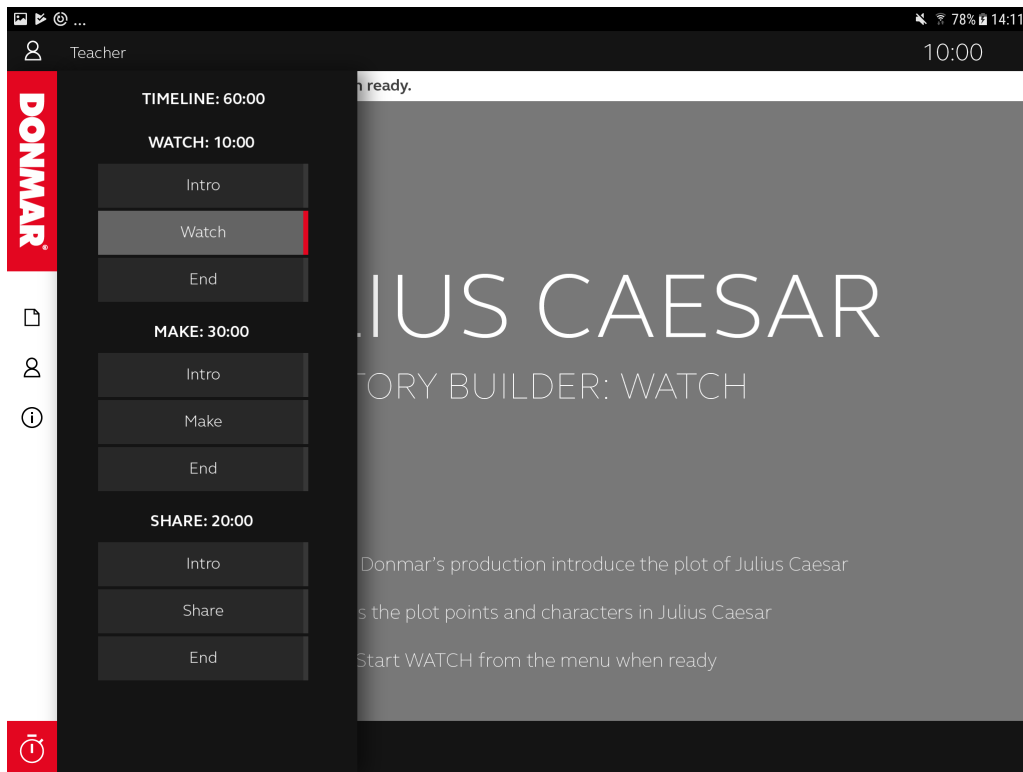


Figure 19 Lesson Timeline – Illustrating how the teacher can enforce progression by selecting the next section in the Watch / Make / Share structure. In this example ‘Watch’ is selected

4.5 Story Builder - Left menu

The left menu provides access to reference material for the module. There are four types of reference material available.

1. Always available across Watch / Make / Share
 - a. Document icon – visual storyboard to remind students of key plot points
 - b. Person icon – visual character family tree with photographs of the cast
 - c. Info icon – A visual 3 step guide to the module and the objectives
2. Only available in Make
 - a. Speech Icon – A visual 3 step guide to the Make task with instructions.

Figure 20 shows how the family tree of characters is represented.

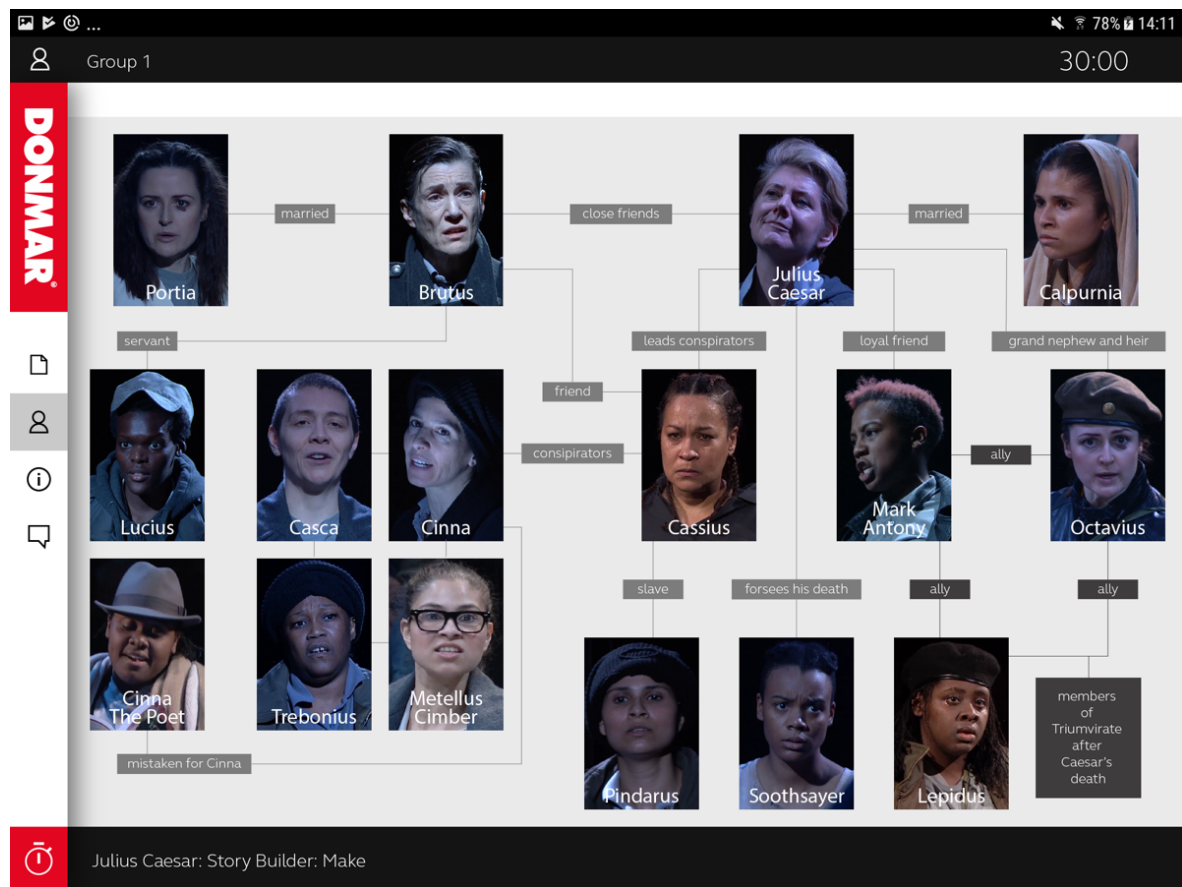


Figure 20 Reference Material – Character Family Tree, accessed from the left menu

4.6 Story Builder - Watch - Overview

This section describes a description of the first part of the lesson, the ‘Watch’ section

The teacher starts Watch to introduce the key plot points to the students and plays the *Julius Caesar Plot* video. This features the actors Jackie Clune (*Julius Caesar*) and Harriet Walker (Brutus) who describe the plot of *Julius Caesar* from their character’s perspective see Figure 21. In Watch, the volume level for both teacher and student companion screens is automatically muted.

The video features twelve titled bookmarks which appear on a visual timeline at the base of the screen and highlight when the timecode for each bookmark is active. The teacher can ‘select all’ to play the whole video or select individual bookmarks to discuss a particular plot point or theme. When a single bookmark has finished playing it remains highlighted in grey until another is selected. A timer displays the length of each bookmark and how long it has left to play.

The teacher is able show the video on all student companion screens. To show supplemental learning material the teacher can change the student display to display stills. These are images from the production, synchronised with the video bookmarks. They include a text overlay which describes the plot point in more detail. The teacher can direct the students’ attention to the main screen by switching the student display to standby mode.



Figure 21 Watch Interface - *Julius Caesar Plot* Video illustrating the titled bookmarks across the bottom of the video

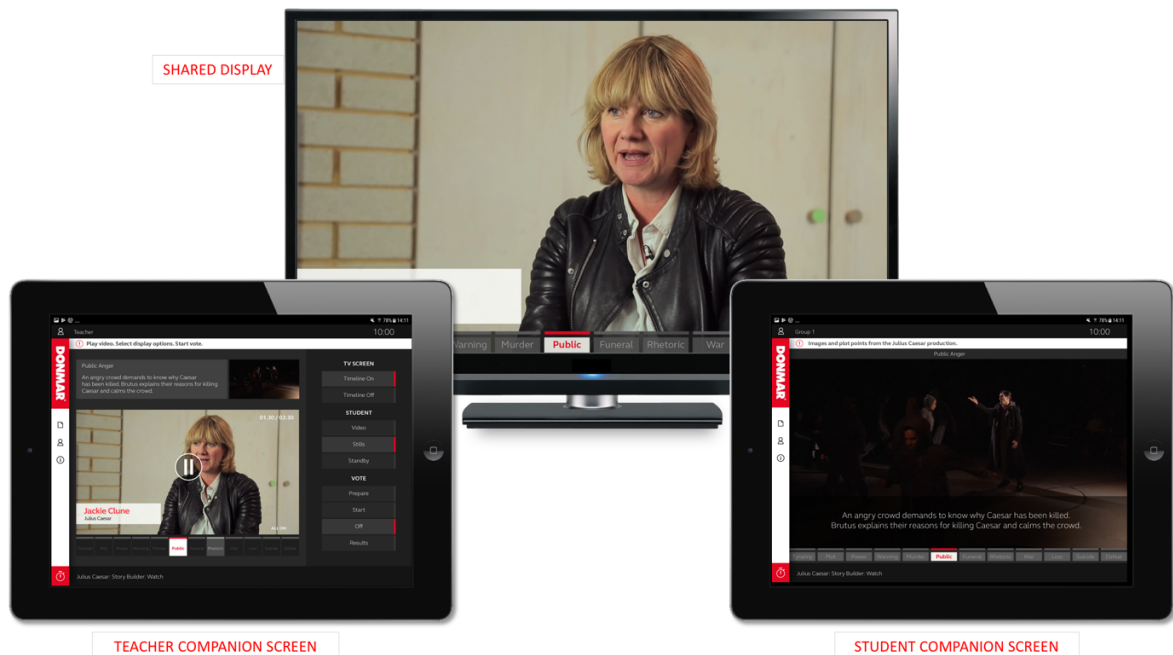


Figure 22 Watch Interface - Synchronised Video and Stills illustrating how the teacher can, using the teacher companion app, control what appears on the pupils' tablets. In this case "stills" are selected and the pupils see relevant stills from the scene rather than video.

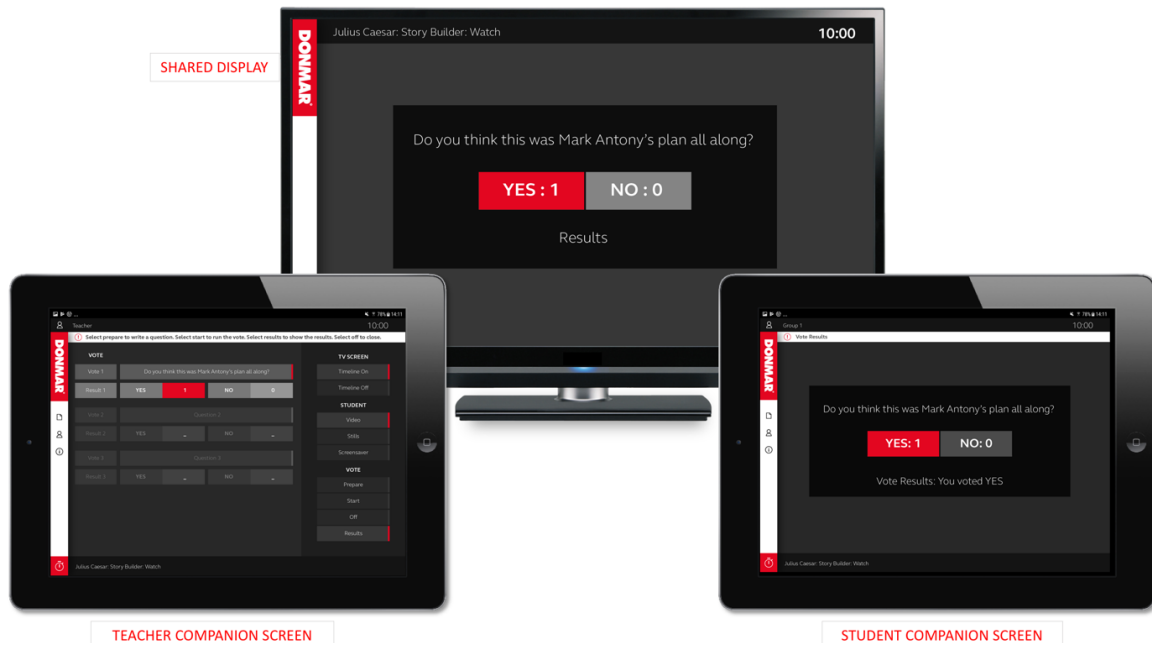


Figure 23 Watch Interface - Synchronised Vote Results

The teacher can use the vote function to run quick polls with the class, see Figure 23, to stimulate debate and check for understanding. The teacher can use the editable template to prepare three questions. Within the Story Builder the answers are set to Yes or No. After starting a vote, the teacher is able to see how many votes have been cast. The results are displayed on the shared display and student companion screens. Each group can see the vote results and their own answer.

4.7 Story Builder - Watch - Interface features

The teacher companion screen interface is shown in Figure 24.

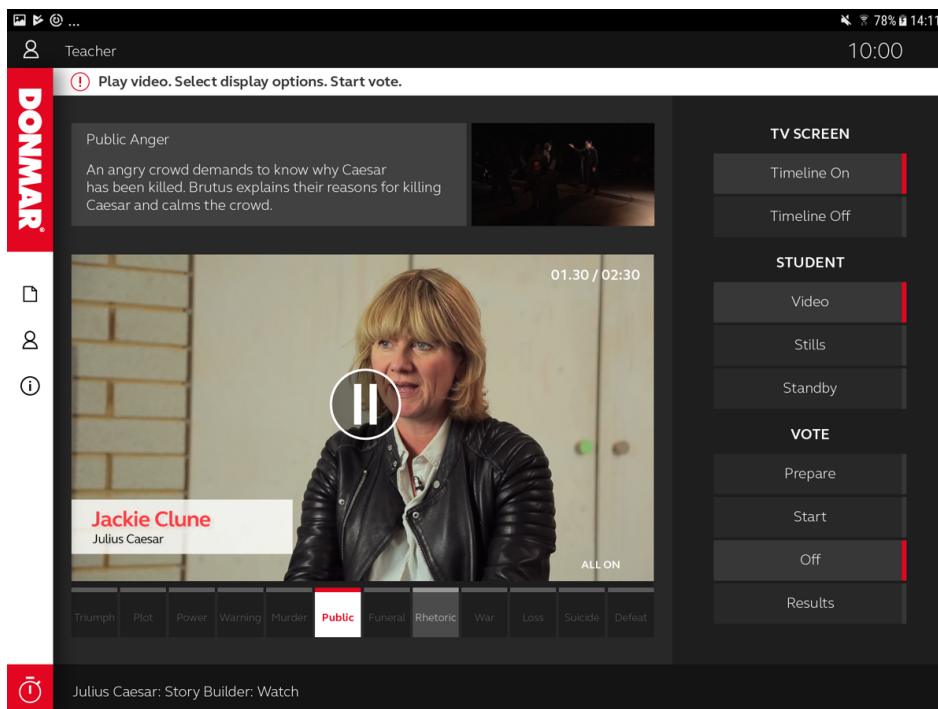


Figure 24 Watch - Teacher Companion Screen – Video

The key features of the Watch companion screen interface include:

1. Media Panel (s)
 - a. Video Player
 - i. Play and pause the video, view time of each bookmark
 - ii. Play all or select specific bookmarks using the bookmark timeline
 - iii. Timeline displays the current bookmark playing
 - iv. Completed bookmark marked in grey until another selected
 - b. Information Panel
 - i. Displays learning content synchronised with the video
 - ii. Shows the plot point text and still image
 - c. Vote Panel – when Vote active (see Figure 25)
 - i. 3 vote panels
 - ii. Text input for questions
 - iii. Live data display
2. Display Controls:
 - a. TV Screen display controls
 - i. Show or hide bookmarks on the shared display
 - ii. Active bookmark is highlighted
 - b. Student Companion screen controls
 - i. Set the display to standby to direct attention to main screen
 - ii. Set the display to show synchronised video mirroring the main screen
 - iii. Set the display to show synchronised stills and learning points
 - c. Vote controls
 - i. Prepare a vote using one of three fields (text input)
 - ii. Start a vote – displayed on TV and student companion screens
 - iii. Monitor live vote progress – results are anonymous
 - iv. Display results of the vote on the TV and student companion screens

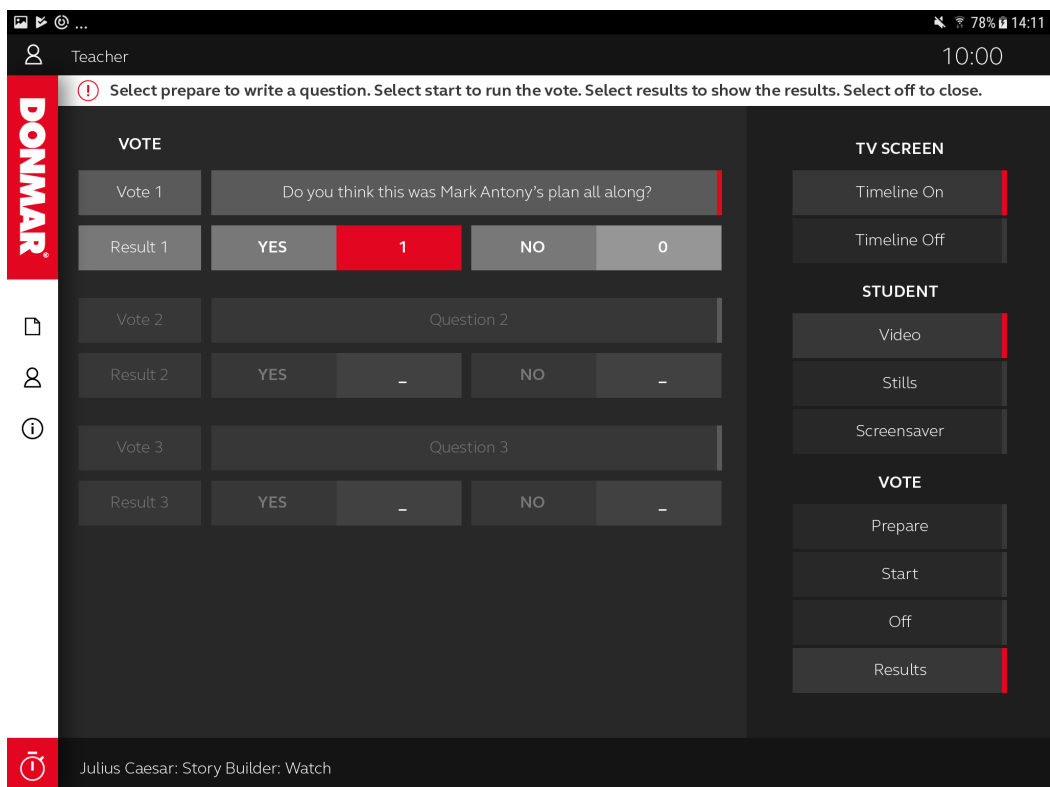


Figure 25 Watch - Teacher Companion Screen – Vote

The student companion screen interface features:

1. Media Panel (see Figure 26 and Figure 27)
 - a. Content viewer
 - i. Video with active bookmarks highlighted
 - ii. Stills from the production with text overlays
 - iii. A standby image
 - b. Vote panel – when Vote Active (see Figure 28 and Figure 29)
 - i. Cast a vote – stays active until vote closes
 - ii. View vote results

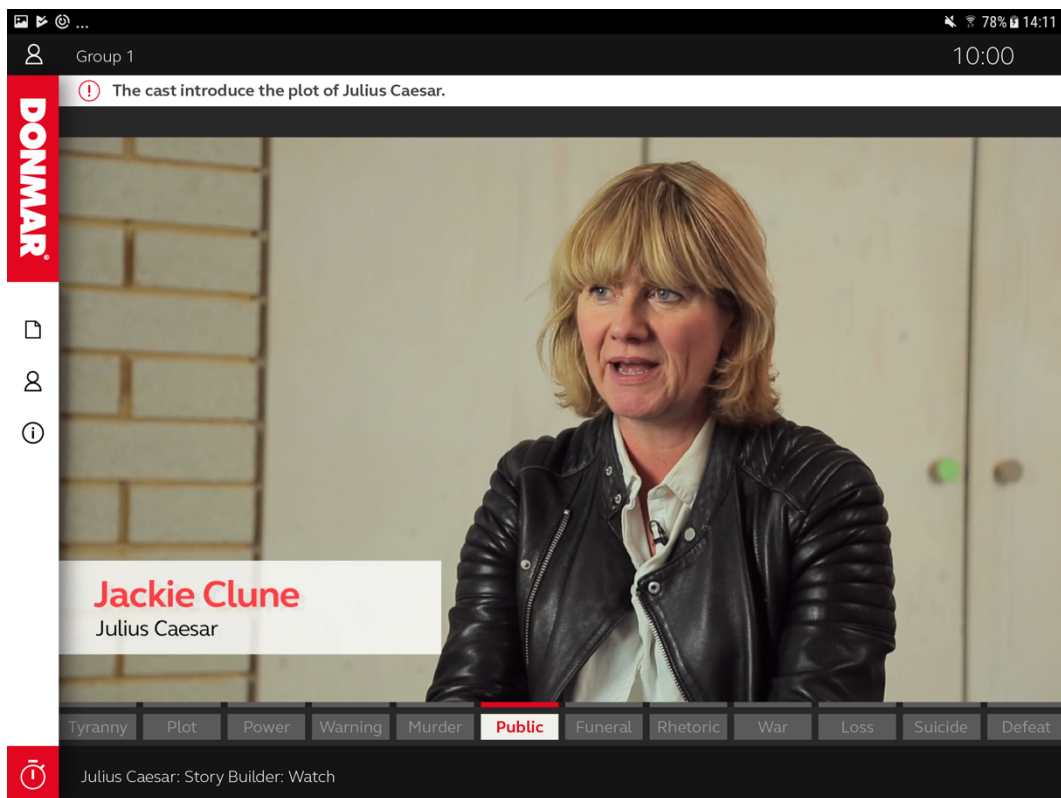


Figure 26 Watch - Student Companion Screen - Video

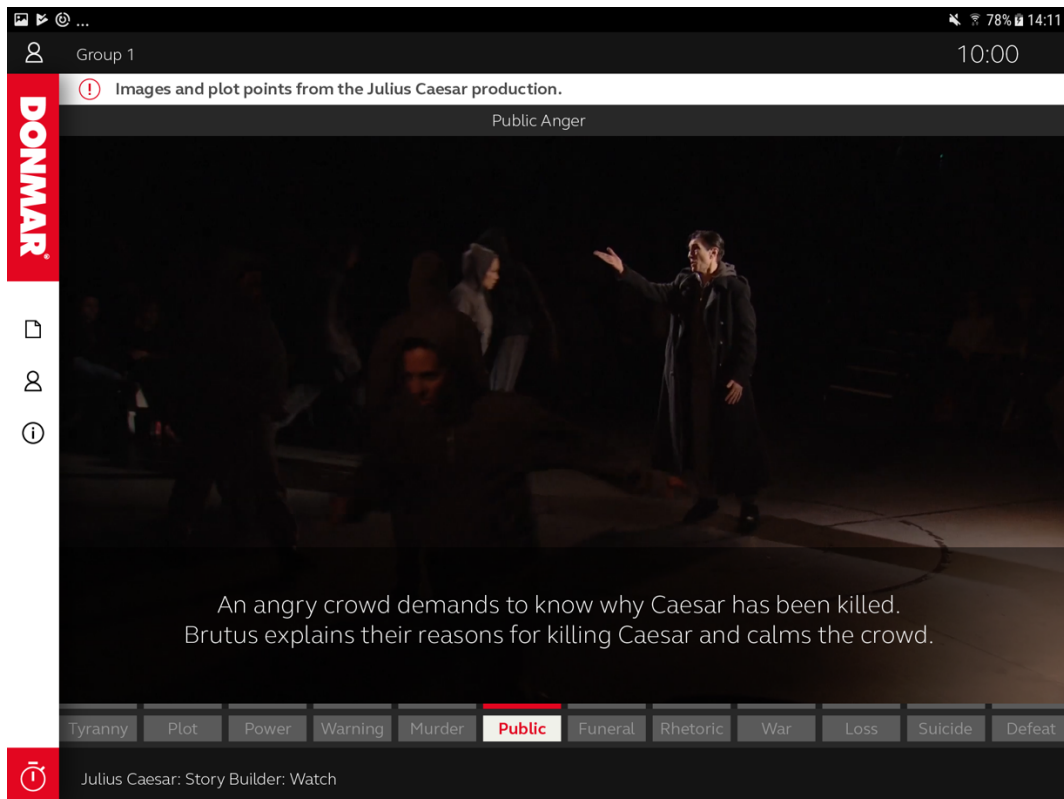


Figure 27 Watch - Student Companion Screen - Stills

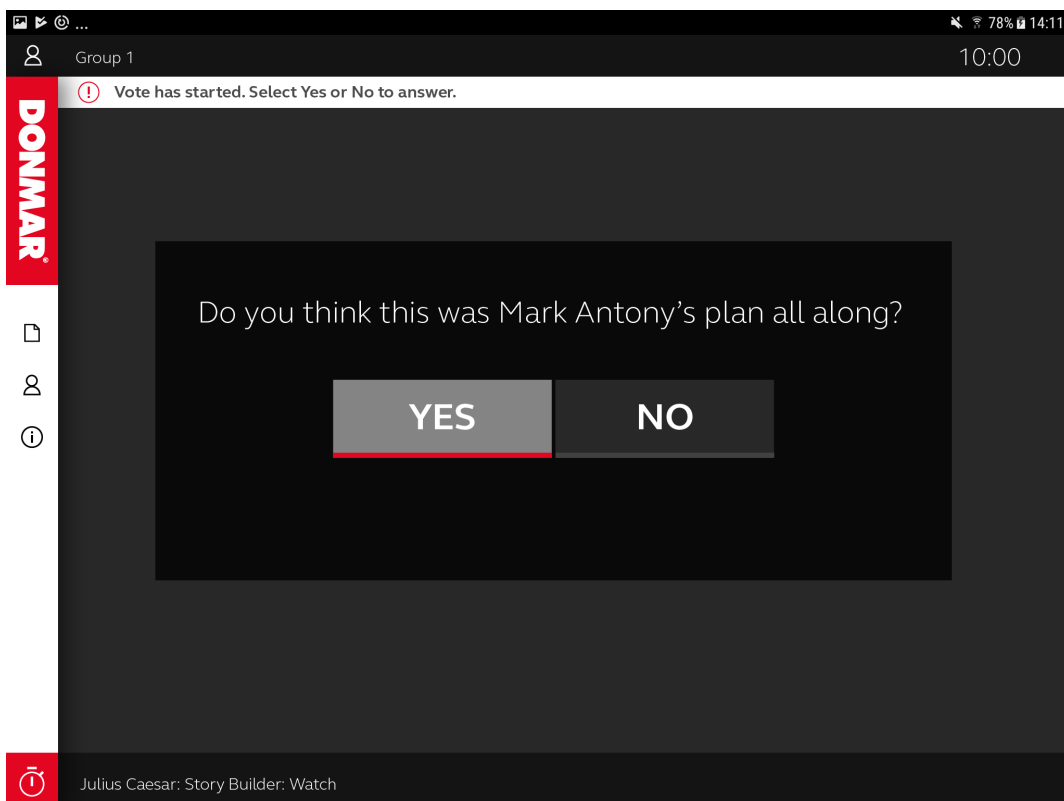


Figure 28 Watch - Student Companion Screen - Cast Vote

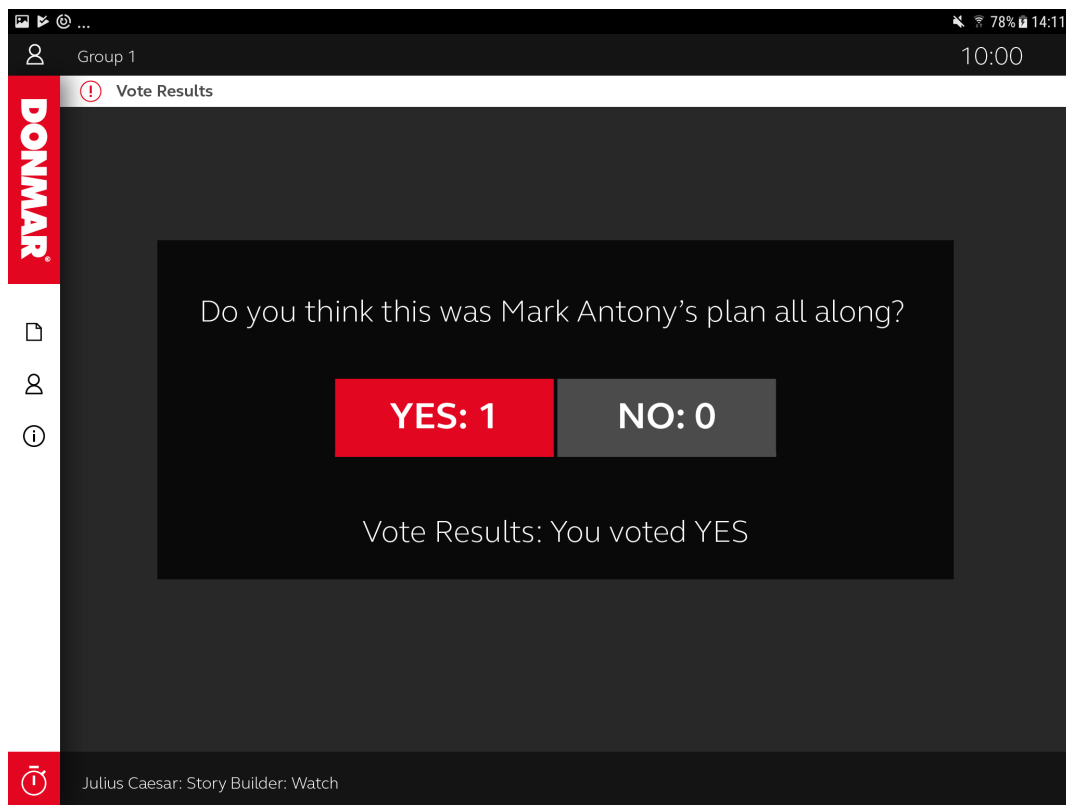


Figure 29 Watch - Student Companion Screen - Vote Results

The shared display (TV) interface features:

1. Video display (see Figure 30)
 - a. Timeline On / Off - Bookmark timeline across the bottom of the screen
2. Media display
 - a. Vote question (see Figure 31)
 - b. Vote results



Figure 30 Watch – Shared Display - Video - Timeline On

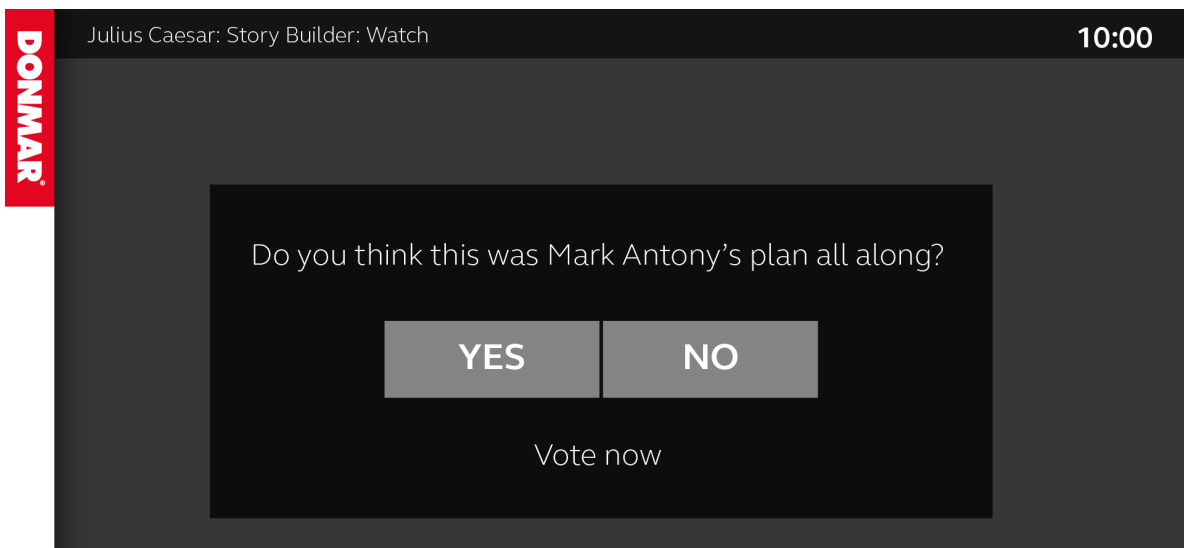


Figure 31 Watch – Shared Display - Media – Vote

4.8 Story Builder - Make - Overview

As noted, the lessons were structured using a Watch / Make / Share structure. This section describes the Make section see Figure 32.

The teacher starts Make and invites students to work on the group exercise. Using the shared display, the teacher can introduce the task and write messages using the whiteboard option. If the teacher sets the student display to standby, this removes active components from the students' screens and helps the teacher to pull attention towards the front (i.e. to the teacher) and away from the companion screens. The teacher can select Story Builder to start the activity on the student companion screens.

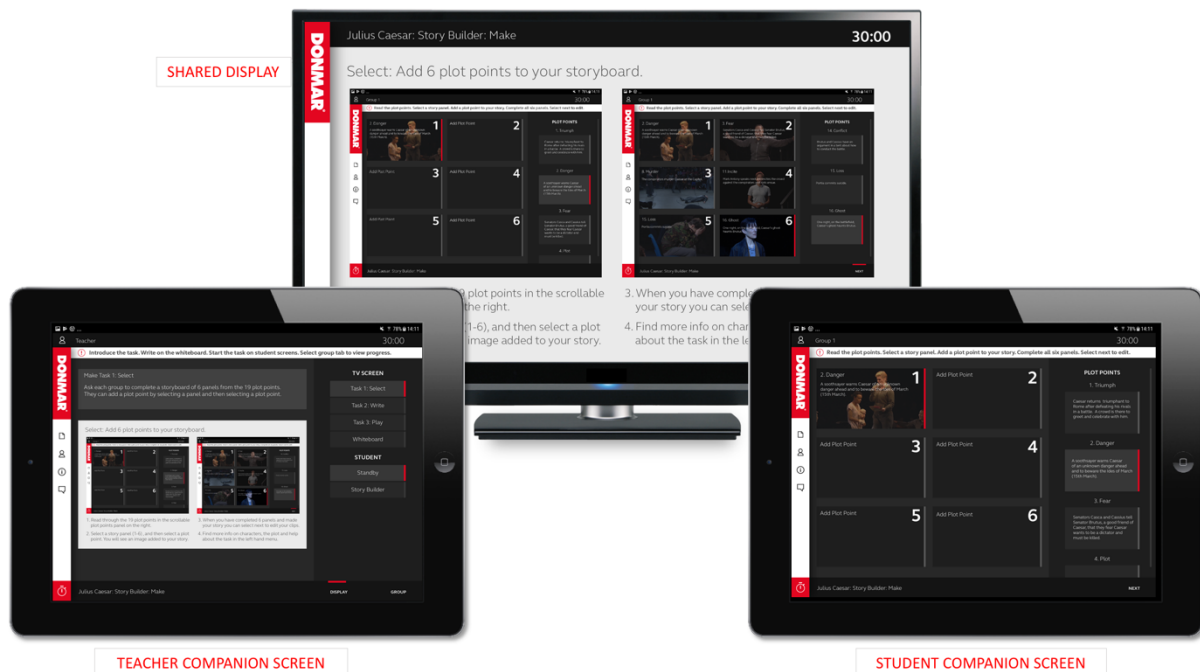


Figure 32 Make Interface – Teacher Task View - Student Story Select

Students complete a 6 panel storyboard by selecting plot points from a scrollable list of 19 plot points. The student selects a story panel and then a plot point which is added to the panel automatically. Each completed panel displays the plot point and an image. The teacher frames the activity which could be to create a synopsis of the story or explore a key theme.

When all 6 panels have been completed the students are able to view and edit their story. A video player is populated with a playlist of 6 clips from the production linked to the selected plot points. The students play each clip, read a key character line from the scene and write their own version of the line in the text box. The students can go back to the story panel and change their selections. The students can set the volume of their companion screens locally.

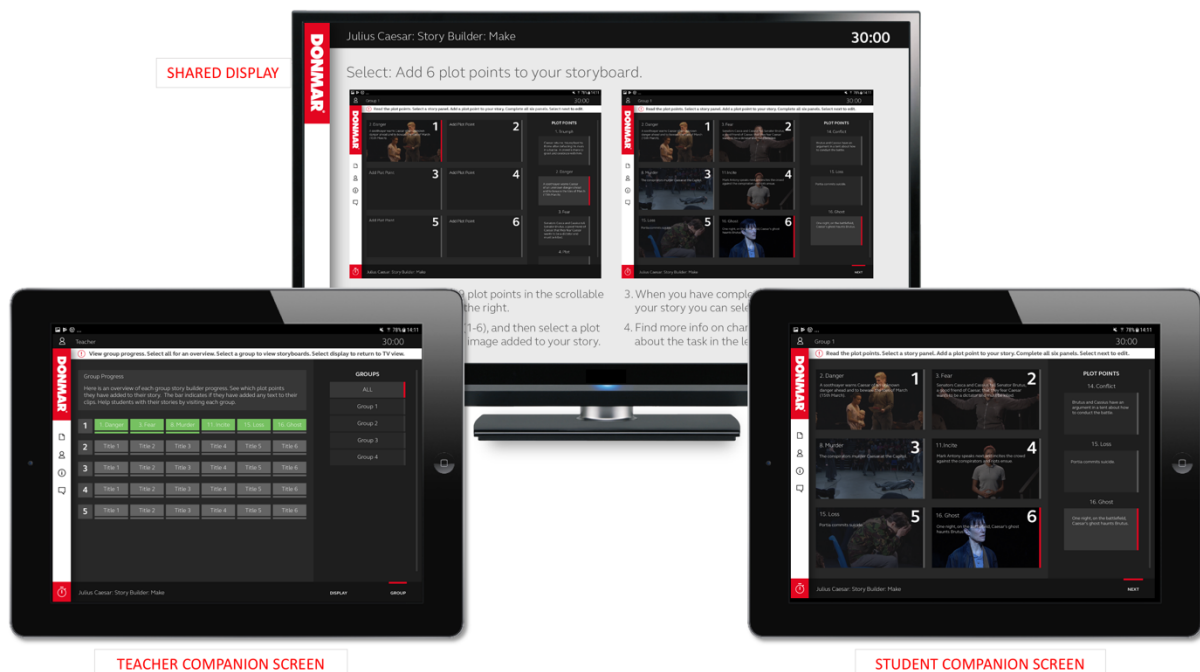


Figure 33 Make Interface – Teacher Group View - Student Story Select

The teacher views the progress of each group in real-time using the group tab in the display panel see Figure 33. The teacher can see an overview of all groups in a visual chart. The chart displays the title of the selected plot points and a bar which highlights when students have annotated the clip. The teacher can view each group storyboard and view the text the students have added. The teacher might use this to see which groups might need help or to discuss their choices see Figure 34.

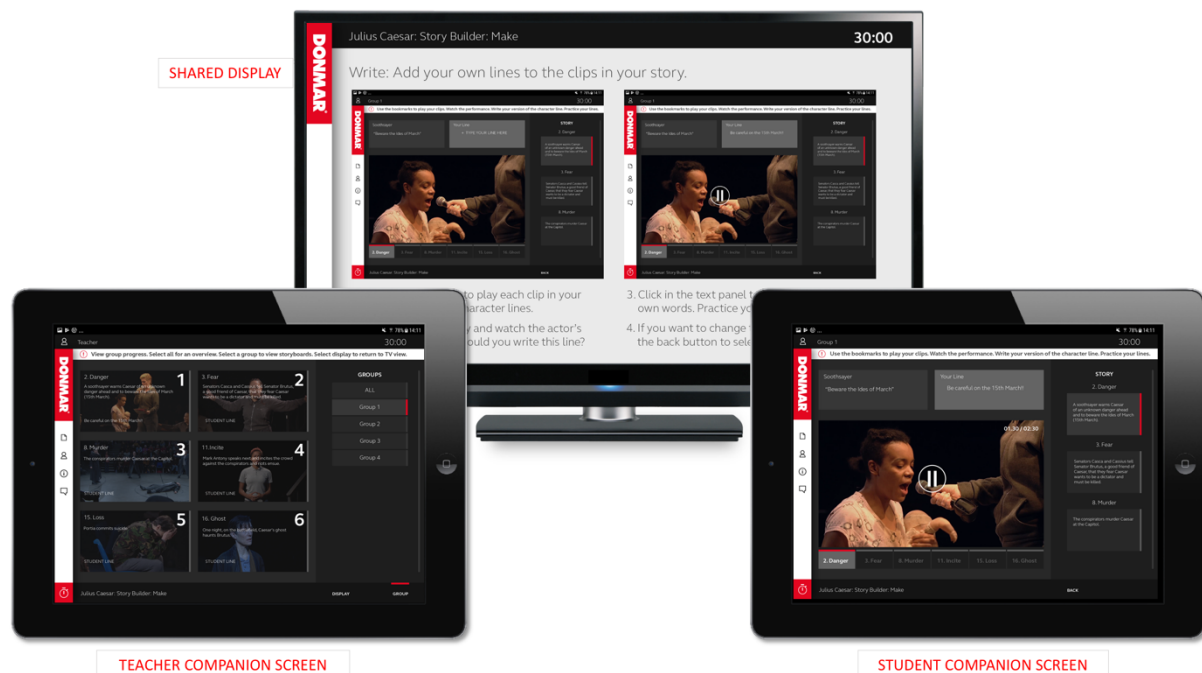


Figure 34 Make Interface – Teacher Group View - Student Edit

4.9 Story Builder - Make - Interface features

4.9.1 The teacher companion screen interface features:

1. Media Panel see Figure 35
 - a. Share display preview
 - i. Information panel outlining current selection
 - ii. Task display selection preview
 - b. Whiteboard window see Figure 36
 - i. Information panel outlining current selection
 - ii. Text input window – share on the TV display when editing complete
 - c. Group Progress window (ALL) see Figure 37
 - i. Information panel outlining current selection
 - ii. Progress panel - group plot point selections and annotation activity
 - d. Group Progress window (Selected Group) see Figure 38
 - i. Selected group 6 panel storyboard
 - ii. Text input from students for each panel
2. Display Control Panel (tab selection):
 - a. TV Screen display controls
 - i. Task descriptions
 - ii. White board
 - b. Student display controls
 - i. Standby
 - ii. Story Builder
3. Group Progress Panel (tab selection):
 - a. Group selection options
 - i. All groups - overview

ii. Individual groups - details

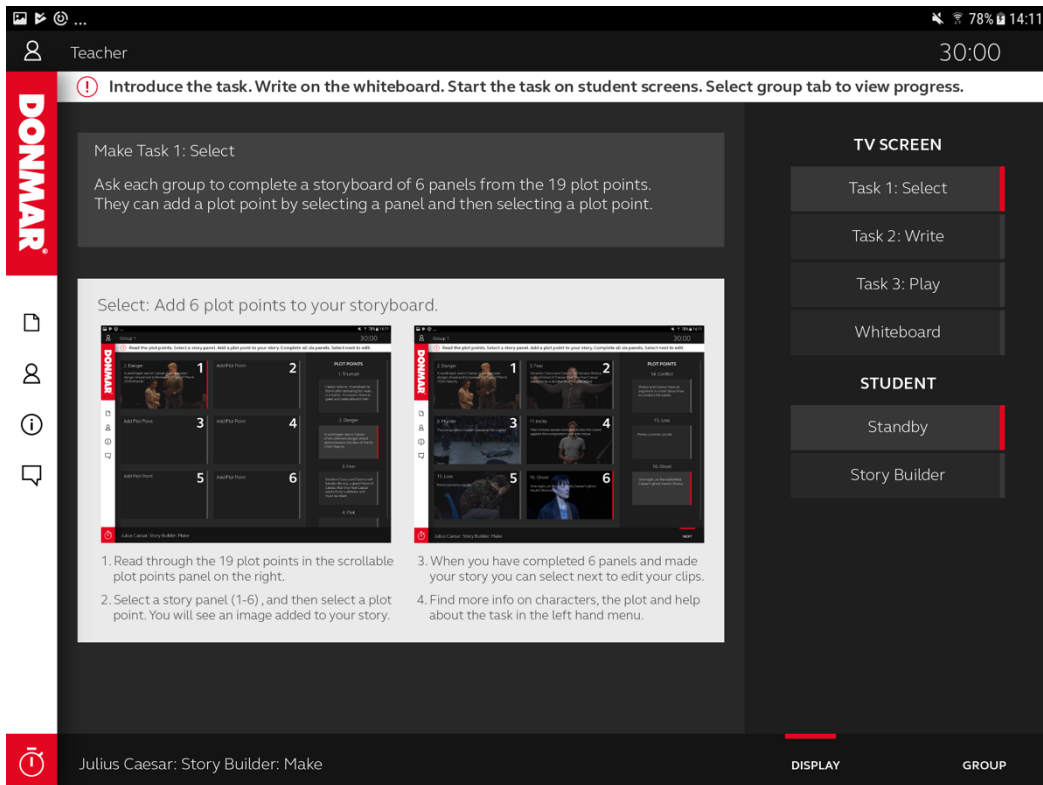


Figure 35 Make - Teacher Companion Screen – Task 1

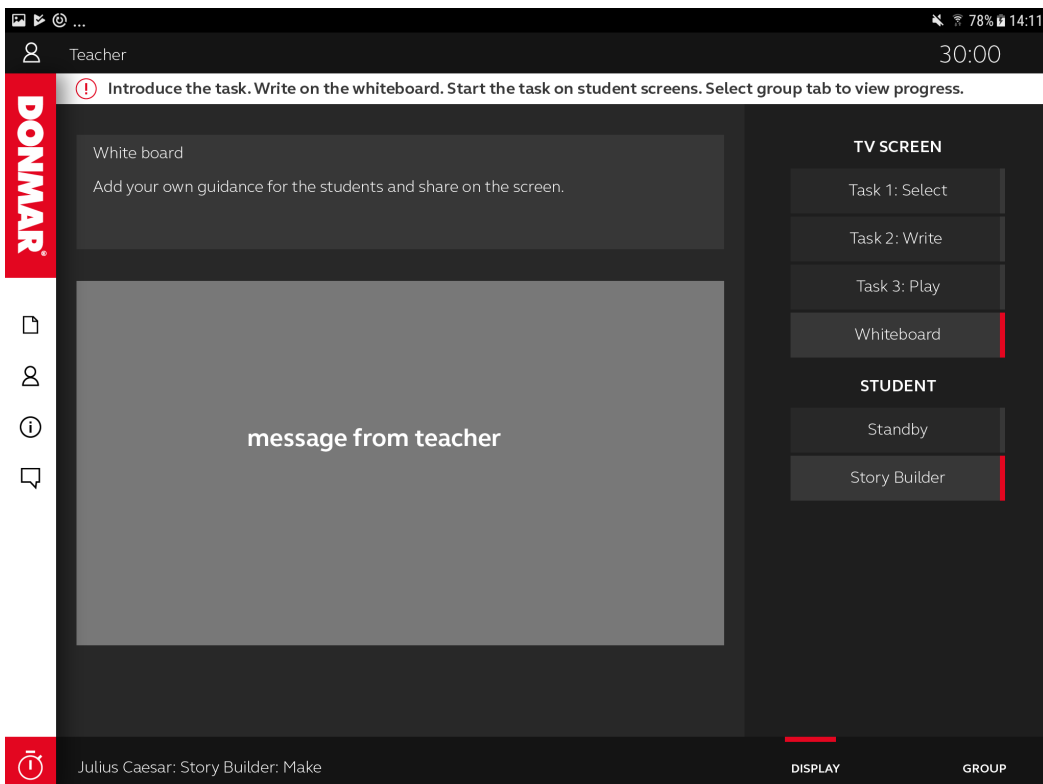


Figure 36 Make - Teacher Companion Screen - Whiteboard

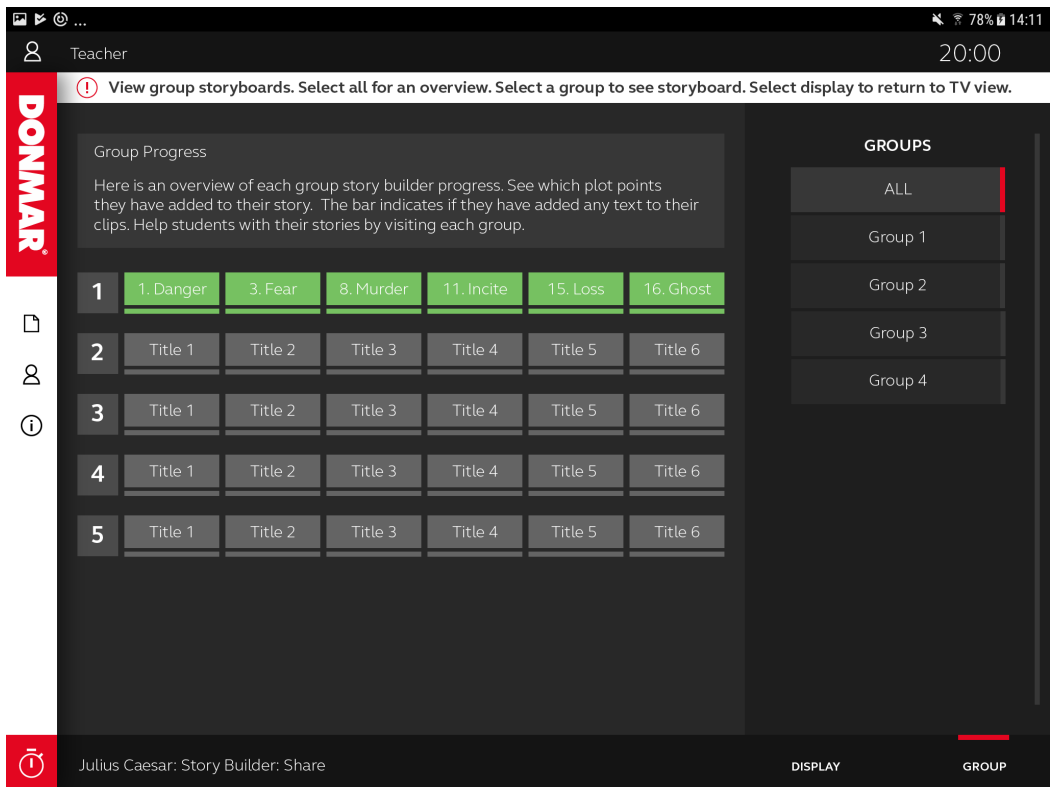


Figure 37 Make - Teacher Companion Screen – Group Progress All

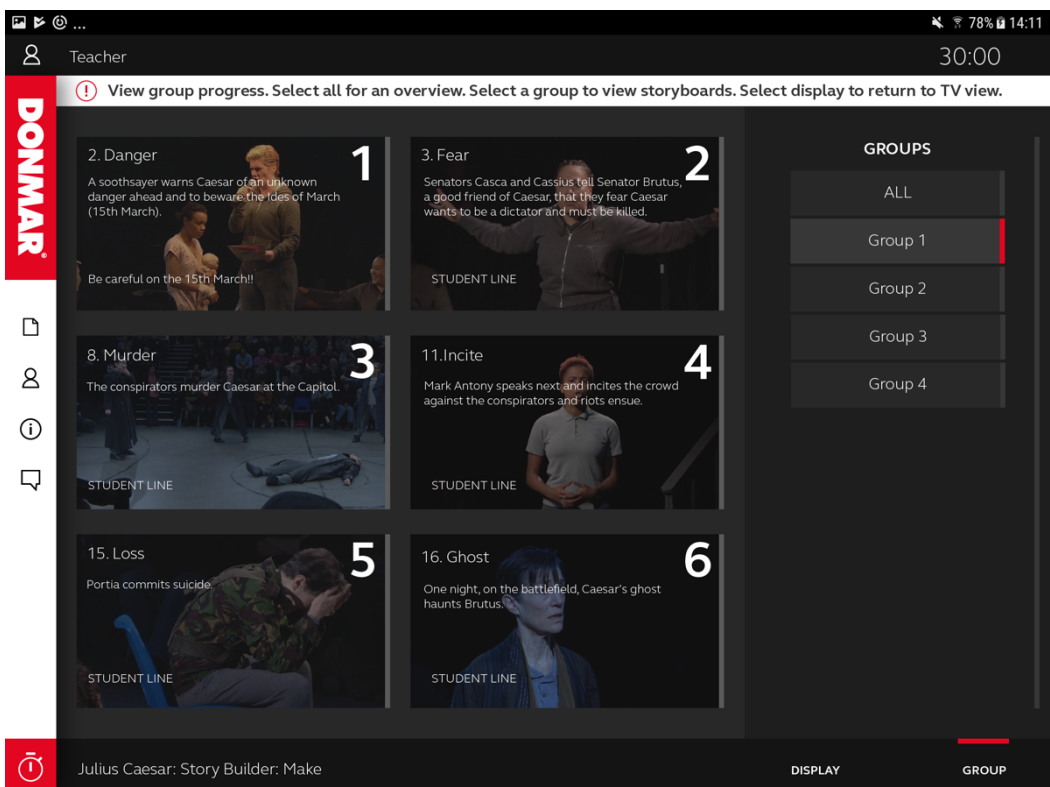


Figure 38 Make - Teacher Companion Screen – Group Progress Group 1

4.9.2 The student companion screen interface features:

1. Media Panel – Complete story panel, see Figure 39
 - a. Plot point panel
 - i. Scrollable list of plot points
 - b. Story panel
 - i. 6 numbered windows with add plot point text
2. Media Panel - Edit story playlist, see Figure 40
 - a. Video Player
 - i. Play and pause individual bookmarks in playlist, timer display
 - b. Text Panels
 - i. Character line panel displaying key character line from clip
 - ii. Text input panel for student to add own line (tablet keyboard)
 - c. Story Panel
 - i. Scrollable list of story playlist plot points, selects bookmarks

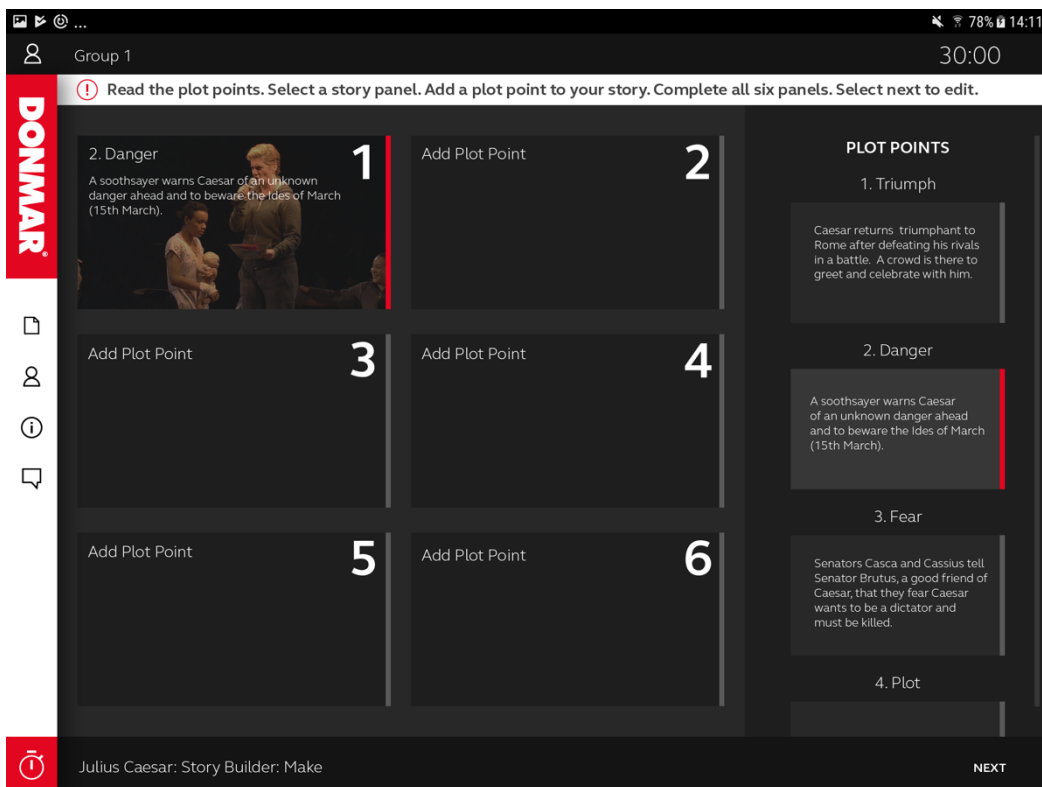


Figure 39 Make - Student Companion Screen – Story Panel

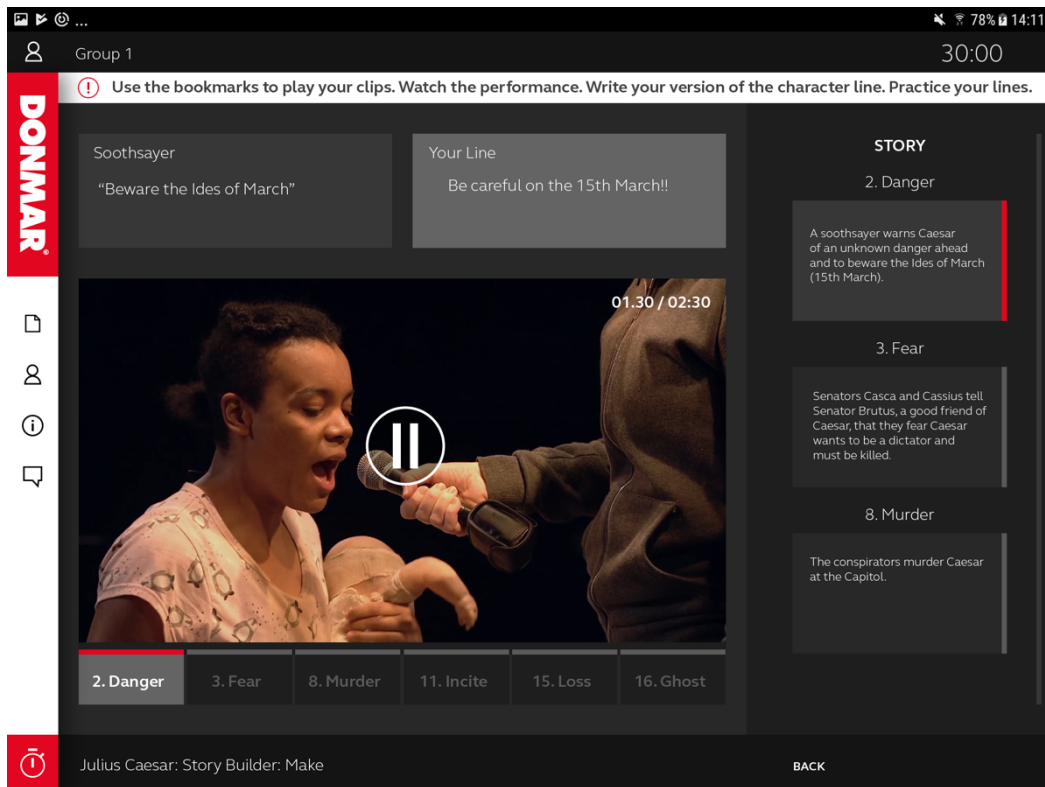
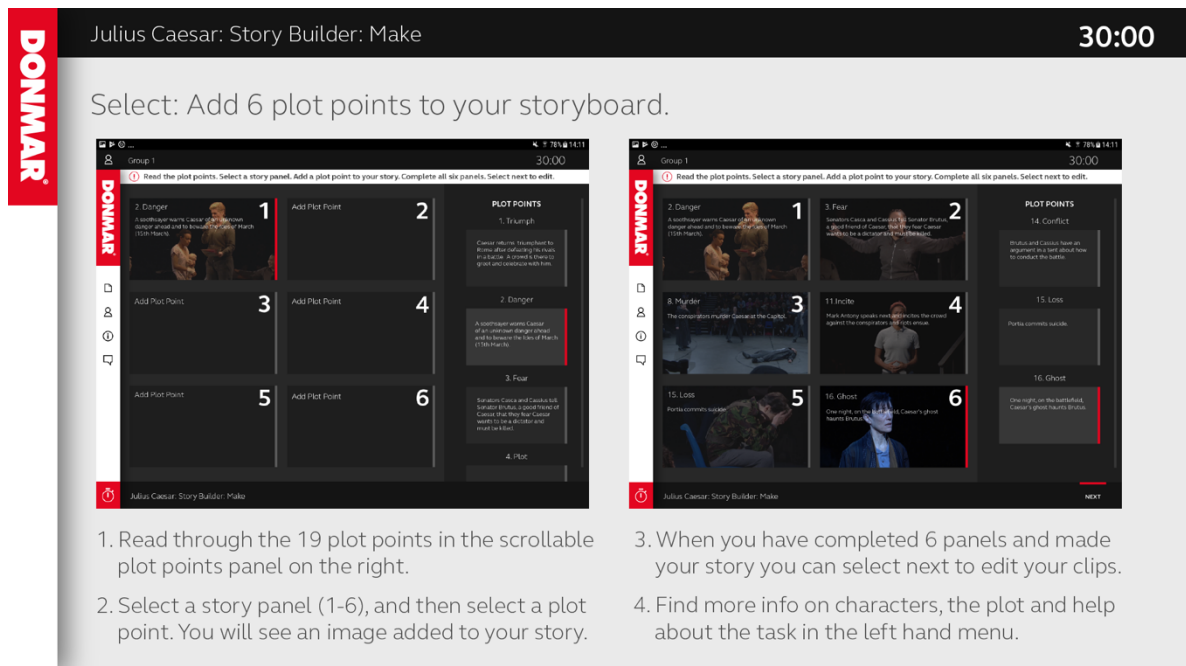


Figure 40 Make - Student Companion Screen – Story Playlist Edit

4.9.3 The shared display (TV) interface features:

1. Media display
 - i. Task descriptions see Figure 41
 - ii. White board see Figure 42



1. Read through the 19 plot points in the scrollable plot points panel on the right.
2. Select a story panel (1-6), and then select a plot point. You will see an image added to your story.
3. When you have completed 6 panels and made your story you can select next to edit your clips.
4. Find more info on characters, the plot and help about the task in the left hand menu.

Figure 41 Make – Shared Display – Media - Task Description

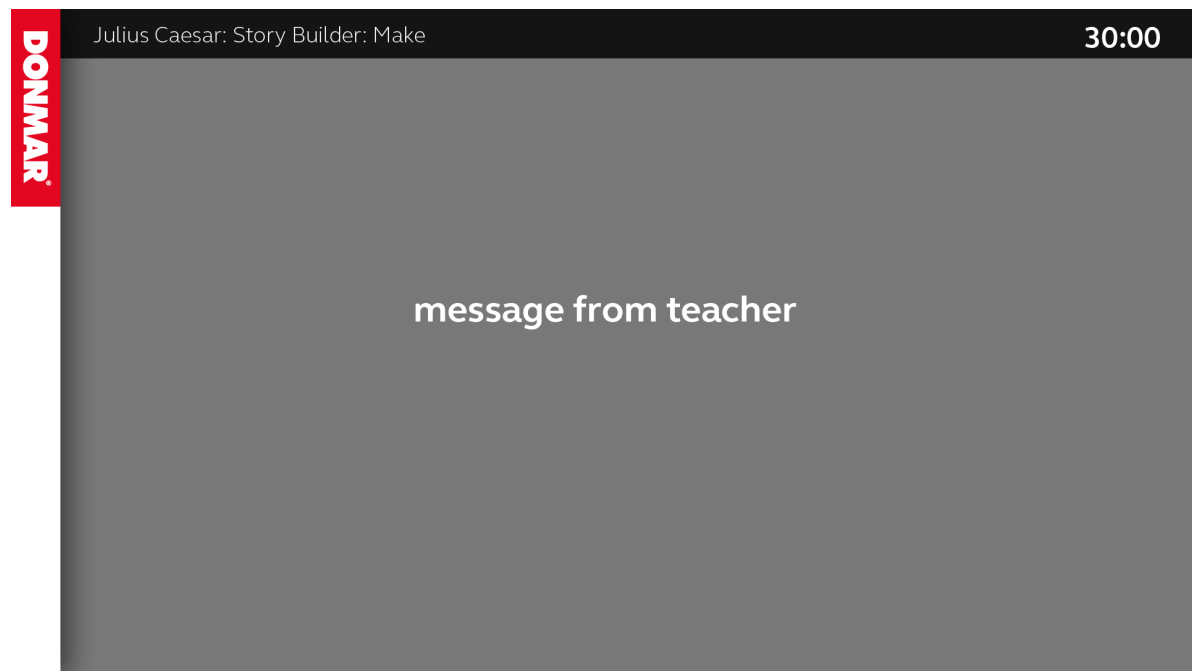


Figure 42 Make – Shared Display – Media – Whiteboard

4.10 Story Builder - Share - Overview

This section describes the final portion of the lesson, the Share section.

The teacher starts Share and invites the students to share their stories with the class. The shared display and all student displays are set to standby by default, see Figure 43. This provides the teacher with the option to preview group stories and decide which group stories to share, and which group should start. There is also the option to select the group tab to view group storyboards and the group progress chart. The volume level for all companion screens is automatically muted.

When the teacher makes the shared display active the current selected group display is set to player mode. The group shares their story and presents their line to the class as directed by the teacher. The annotations on each clip appear as a text overlay on the shared display. The bookmark timeline highlights the current clip playing and the title of the bookmark.

The teacher companion screen shows the video player, populated with the current group playlist. This provides the teacher with the option to take control at any time and pause the presentation to ask questions and encourage group discussion.

The teacher has the option to keep the other student displays on standby, to direct their attention to the shared display, or set the student displays to viewer mode which will mirror the shared display screen. When the teacher selects another group to share their story, their display changes to the player mode and all other groups are set to viewer or standby mode.



Figure 43 Share Interface – Teacher Preview – Displays on Standby

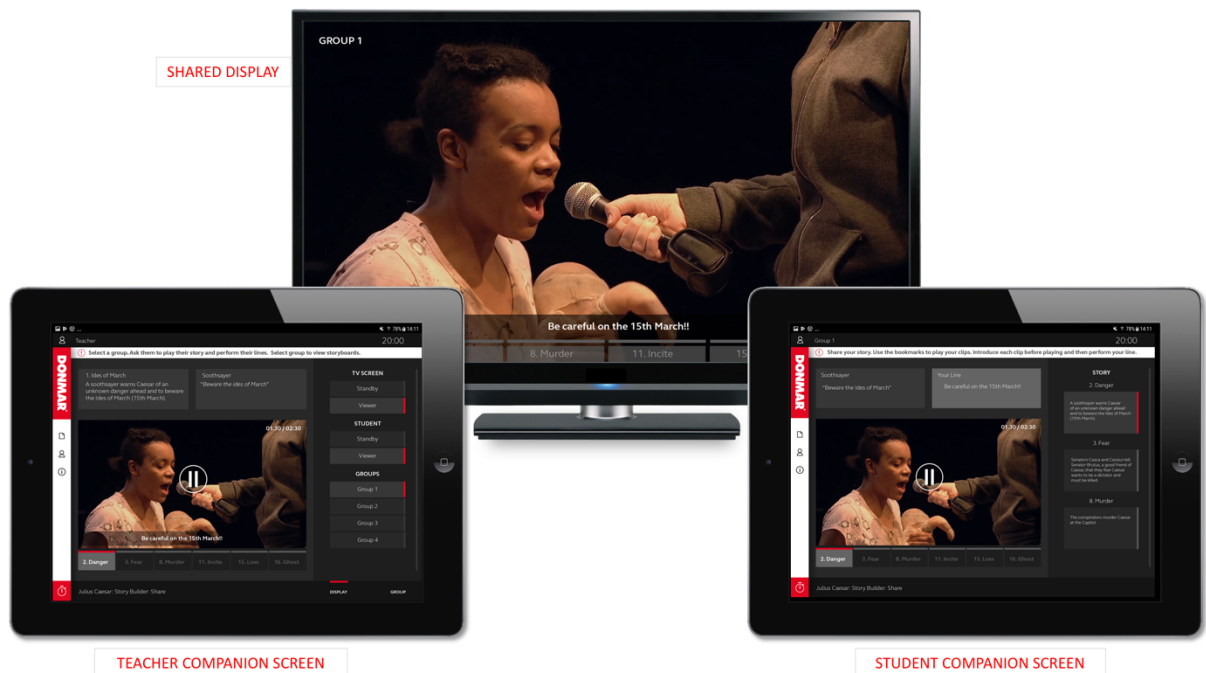


Figure 44 Share Interface – Teacher Select Group 1 – Student Group 1 Player

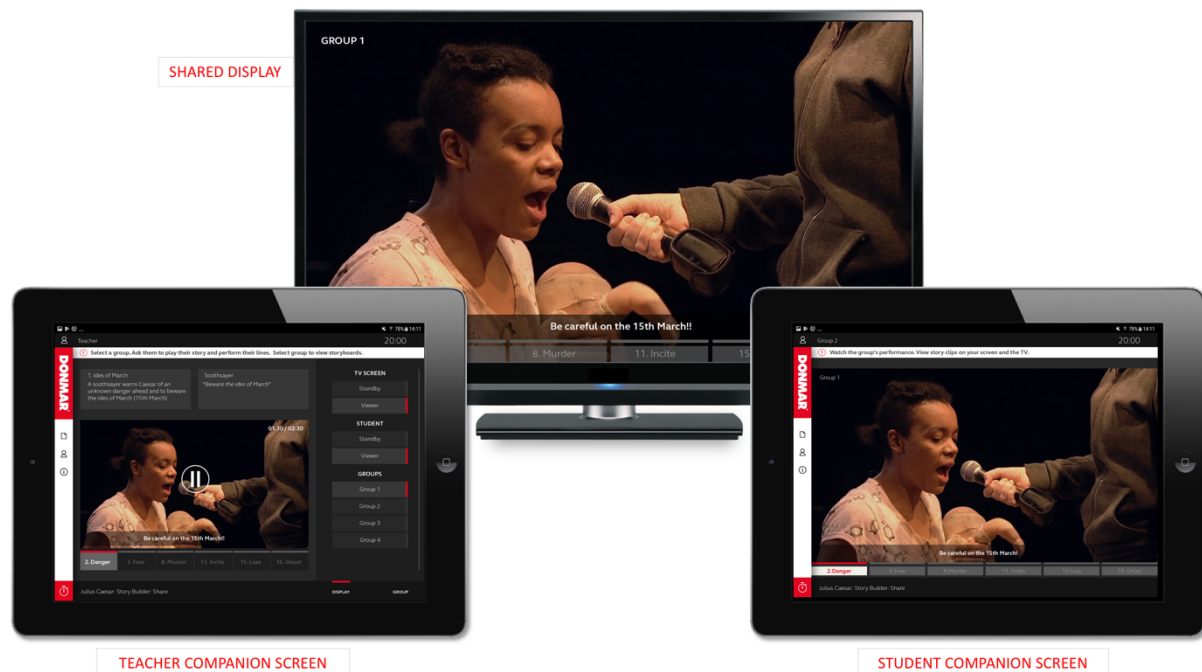


Figure 45 Share Interface – Teacher Select Group 1 – Student Group 2 Viewer

4.11 Story Builder - Share - Interface features

4.11.1 The teacher companion screen interface features:

1. Media Panel
 - a. Video Player, see Figure 46
 - i. Play and pause specific bookmark, timer display
 - ii. Active bookmark highlighted
 - iii. Completed bookmark grey until another selected
 - iv. Text overlay displaying character line over the video
 - b. Text Panels
 - i. Character line panel displaying key character line from clip
 - ii. Student line panel displaying student line
2. Display Control Panel (tab selection):
 - a. TV Screen display controls
 - i. Standby – overrides all screens to standby
 - ii. Viewer – shows group selection, enables student display selection
 - b. Student display controls
 - i. Standby – student displays set to standby, selected group player
 - ii. Viewer – student displays set to viewer, selected group player
3. Group Progress Panel (tab selection):
 - a. Group selection options
 - i. All groups – overview, see Figure 47
 - ii. Individual groups - details

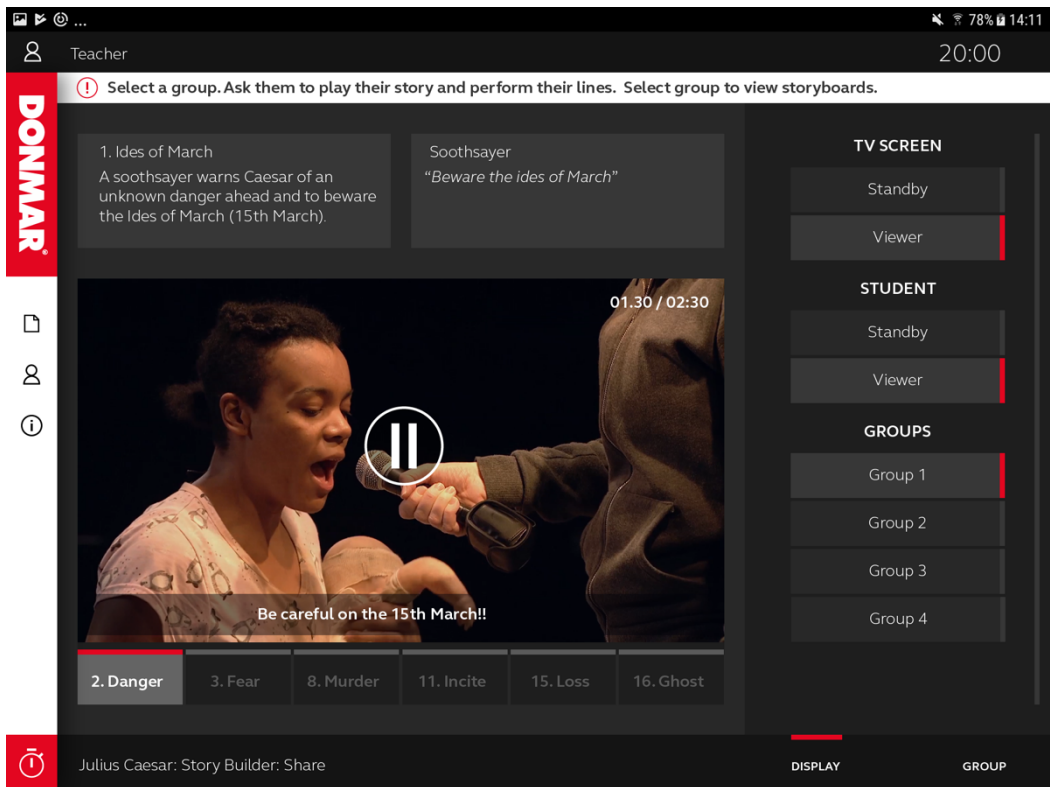


Figure 46 Share - Teacher Companion Screen – Video

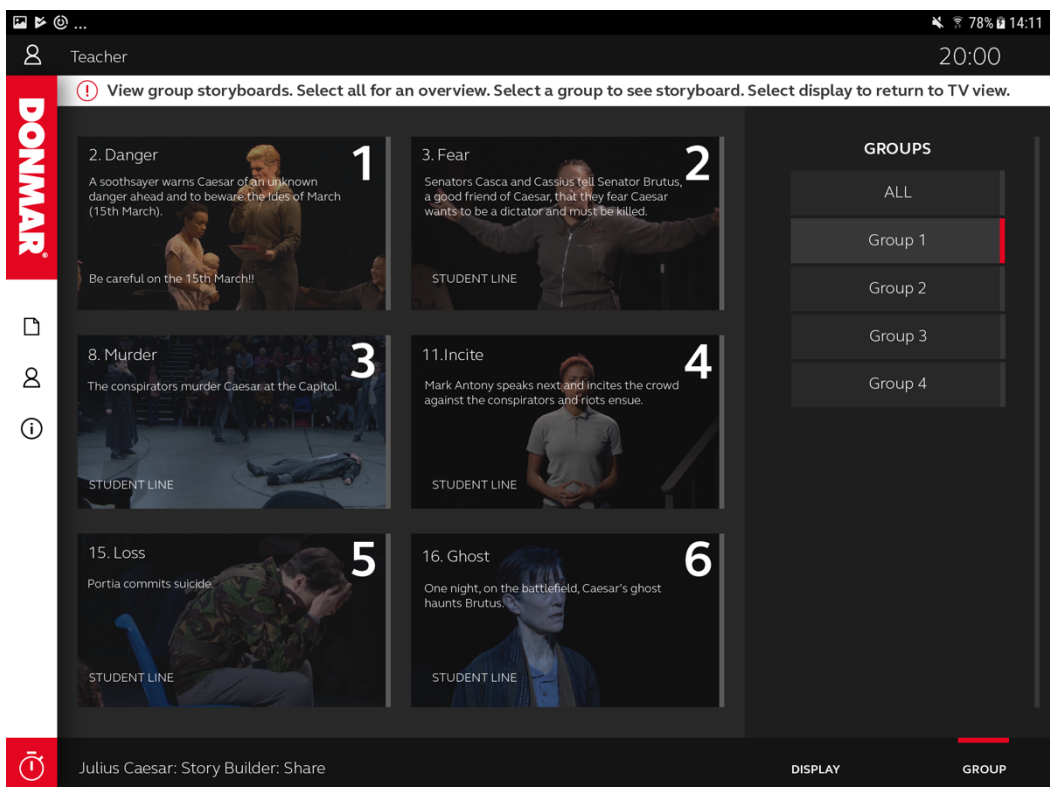


Figure 47 Share - Teacher Companion Screen – Group Storyboard

4.11.2 The student companion screen interface features:

1. Media Panel -Viewer
 - a. Video viewer
 - i. Video with active bookmarks highlighted, see Figure 48
 - ii. Text overlay displaying character line over the video, see Figure 49
 - iii. Group Identifier

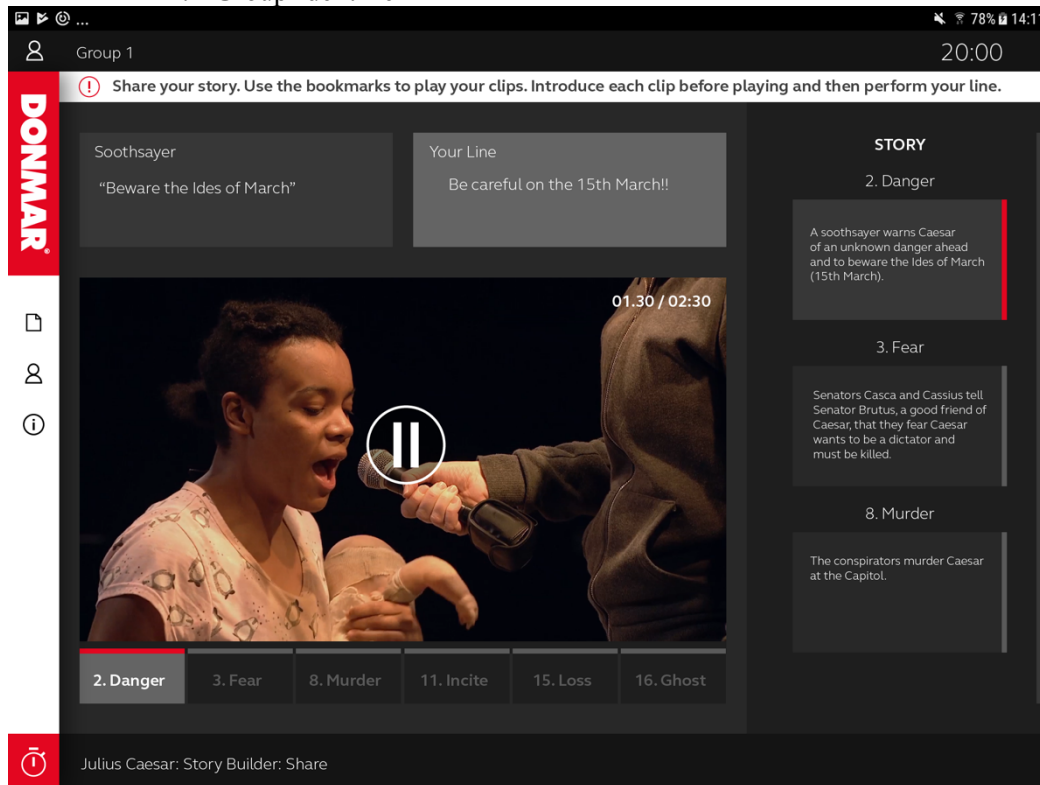


Figure 48 Share - Student Companion Screen – Player

1. Media Panel - Player
 - a. Video Player
 - i. Play and pause individual bookmarks in playlist, timer display
 - b. Text Panels
 - i. Character line panel displaying key character line from clip
 - ii. Student line panel displaying student line
 - c. Story Panel
 - i. Scrollable list of story playlist plot points, selects bookmarks

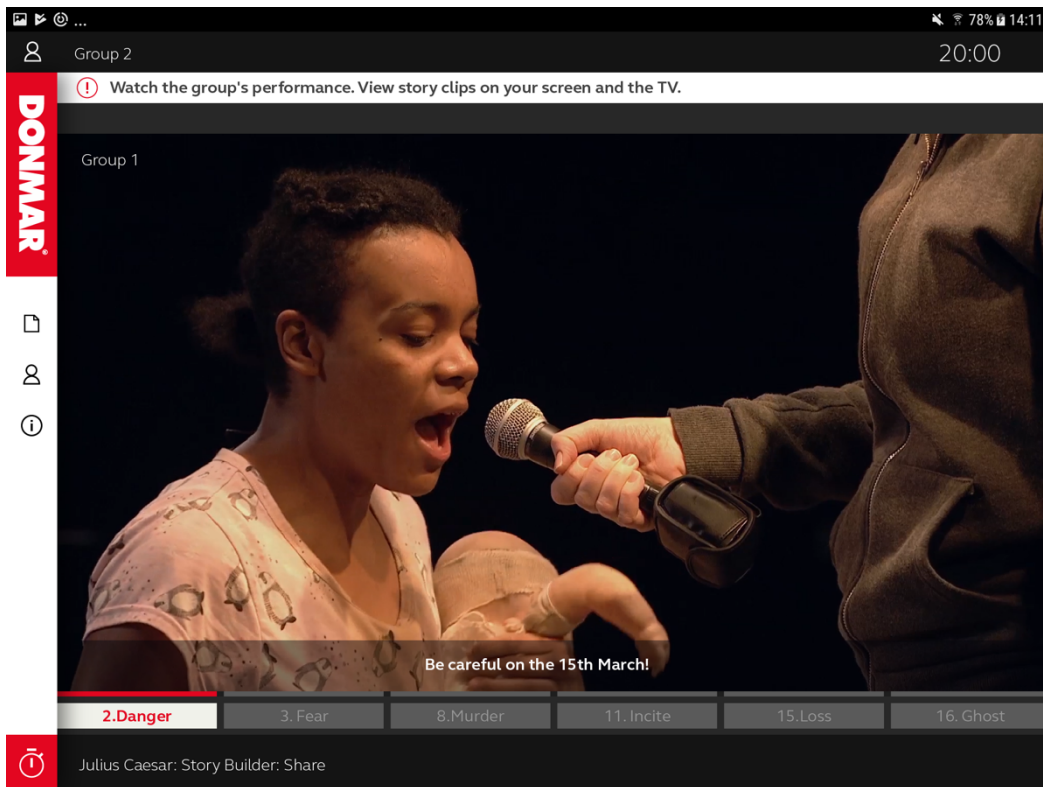


Figure 49 Share - Student Companion Screen – Viewer

4.11.3 The shared display (TV) interface features:

2. Video display
 - a. Selected group video
 - b. Group identifier
 - c. Text overlay displaying character line over the video, see Figure 51
 - d. Bookmark timeline across the bottom of the screen



Figure 50 Share – Shared Display - Standby



Figure 51 Share – Shared Display – Video

5 Script Detective - Prototype Service Description

The Script Detective lesson is designed to help students explore and understand better the use of rhetorical devices and their impact through the speeches in *Julius Caesar*. The next few sections describe the lesson was delivered with the Watch / Make / Share framework in more detail.

5.1 Script Detective - Learning objectives

The learning objectives of this lesson is to support a deeper understanding of the use of rhetoric and of the way rhetorical devices can be used to achieve particular effect. This is done in the context of ‘Friends, Romans, Countrymen’ speech. The key learning outcomes are for students to be able to:

- Analyse language used in plays
- To be able to recall and describe different rhetorical devices
To understand the effect different forms of rhetoric have on the listener.

5.2 Script Detective - Source material

The source material for the content of this module include:

1. Video
 - a. *Julius Caesar - 'Friends, Romans, Countrymen' Insight* –
 - i. A 4 minute 39 seconds introduction to the speech segment
 - ii. 10 bookmark sections marked up in the video
 - iii. Each bookmark labelled with a theme identifier
 - b. *Julius Caesar - Act 3, Scene 2 - Friends, Romans, Countrymen*
 - i. 16 virtual speech clips bookmarked in the film segment
 - ii. Each speech clip linked to a script segment from the speech
2. Learning Content
 - a. 16 speech video clips from key points in the speech
 - b. 16 speech script segments, each linked to a video clip
 - c. 12 literary devices definitions
 - d. An outline of the stories of Brutus, Caesar and Mark Antony and the plot so far
 - e. 10 stills from the production and text learning points from the *Insight* video
 - f. A hint for each speech clip with a clue about Mark Antony’s intention
3. Donmar Learning Resource Reference - Downloadable pdf file
 - a. 164 - *Julius Caesar* Persuasive Language
 - b. 167 - *Julius Caesar* Supporting Questions for the Friends Romans Countrymen Clip

5.3 Script Detective - Common features across the lessons

With the Story Builder module built we established common features for the prototype.

Within Script Detective the screen configuration, tablet interface, lesson timeline and left menu remain consistent, with some content changes. The Watch mode is also structurally the same, but with different content.

The main differences for Make include a different selection process for working with speech clips and more annotation options. In Share we retained the ability to share group work in turn and developed new methods for aggregating group contributions on the shared display.

5.4 Script Detective - Lesson timeline

The teacher initiates different parts of the module using the Lesson Timeline Icon (clock) at the bottom of the left panel. The menu uses radio buttons, so only one selection can be made see Figure 52. Students can access the same timeline menu, but in display mode only. The panel is closed by clicking anywhere else on the screen or clicking the icon.

3. The teacher can select the Watch / Make / Share options to start each task immediately
 - a. Start Watch
 - b. Start Make
 - c. Start Share
4. The teacher can share introduction and end screens between modes
 - a. Intro – displays contextual text about the objectives for the activity
 - b. End – displays contextual text summarising the activity.

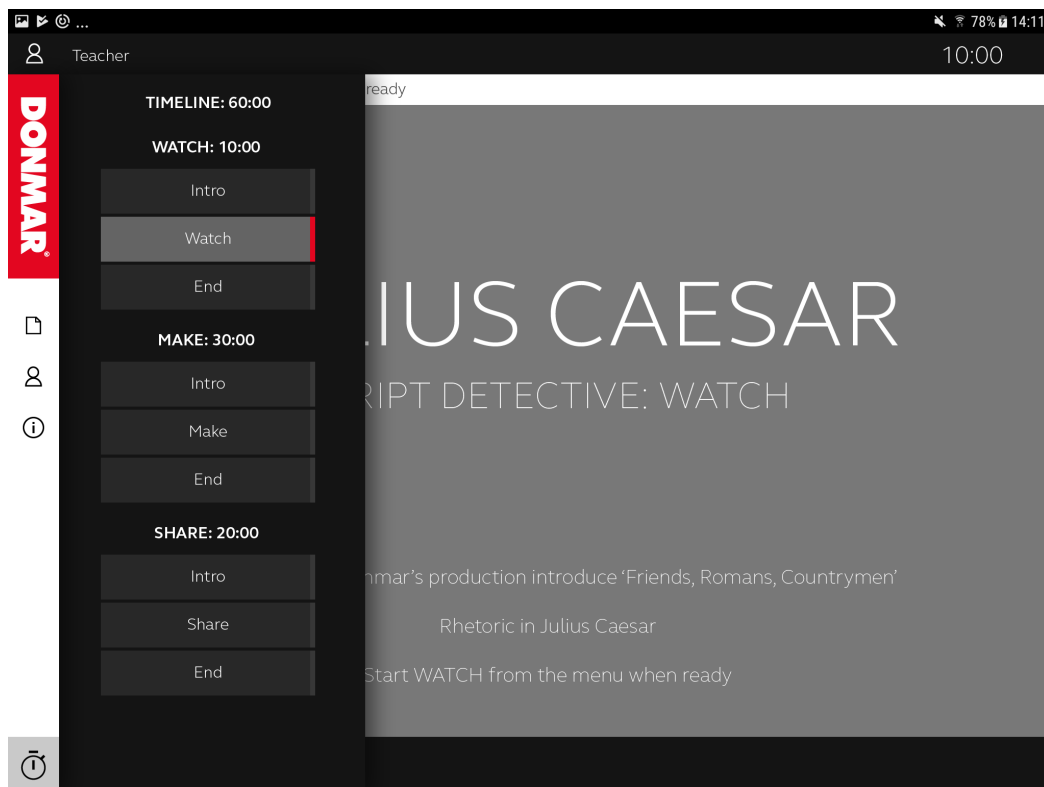


Figure 52 Lesson Timeline – Watch Selected

5.5 Script Detective - Left menu

The left menu provides access to reference material for the module. There are four types of reference material available.

1. Always available across Watch / Make / Share
 - b. Document icon – literary devices and definitions in modern English, see Figure 53
 - c. Person icon – speech reference visual character descriptions and story so far
 - d. Info icon – A visual 3 step guide to the module and the objectives
2. Only available in Make
 - e. Speech Icon – A visual 3 step guide to the Make task with instructions

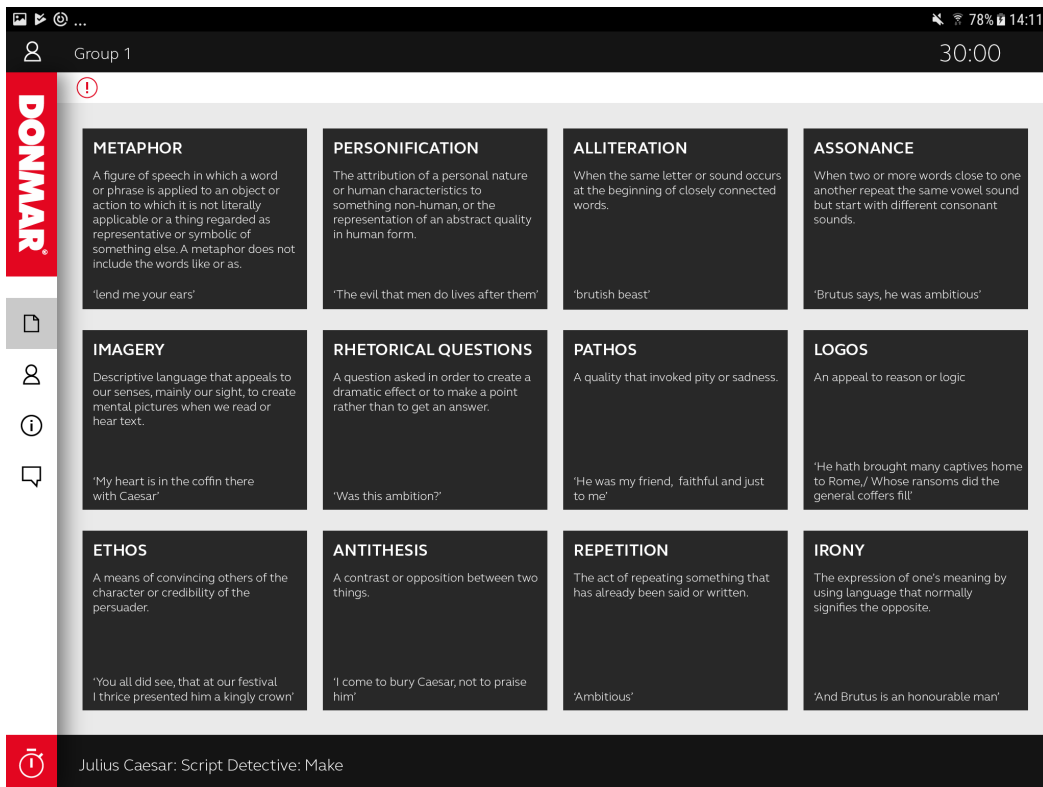


Figure 53 Reference Material – Literary Devices and Definitions

5.6 Script Detective - Watch - overview

This section describes the Watch portion of the Script Detective lesson. The teacher starts with ‘Watch’ to introduce the ‘Friends Romans Countrymen’ speech to the students and play the *'Friends, Romans, Countrymen' Insight* video. This features the actors Jade Anouka (Mark Antony) and Jackie Clune (*Julius Caesar*) who describe the techniques Mark Antony uses to manipulate the crowd in the famous speech and some of the techniques used by the actors in their performance, see Figure 54. In Watch, the volume level for both teacher and student companion screens is automatically muted.

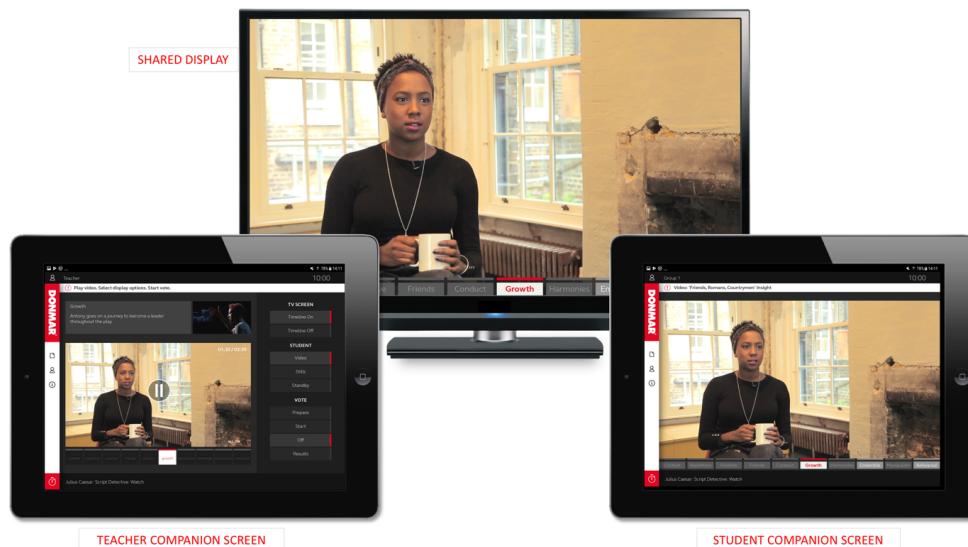


Figure 54 Watch Interface - 'Friends, Romans, Countrymen' Insight Video

The video features 10 titled bookmarks. The titles appear on a visual timeline and highlight when the timecode for each bookmark is active. The teacher can ‘select all’ to play the whole video or select individual bookmarks to discuss a particular plot point or theme. When a single bookmark has finished

playing it remains highlighted in grey until another is selected. A timer displays the length of each bookmark and how long it has left to play.

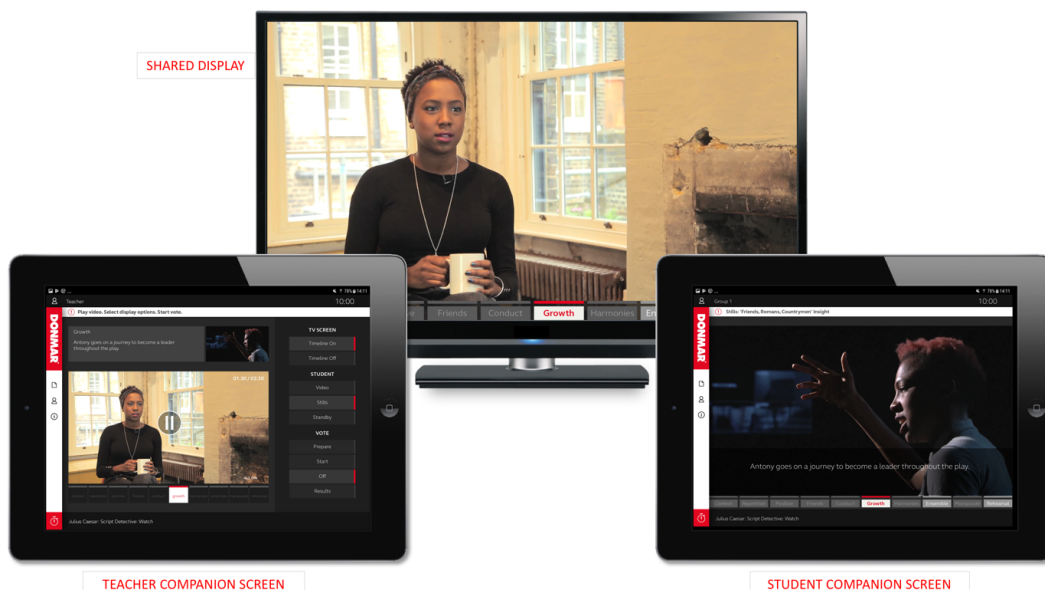


Figure 55 Watch Interface - Synchronised Video and Stills

The teacher is able to show the video on all student companion screens. To show supplemental learning material the teacher can change the student display to show stills, see Figure 55. The stills are images from the production, synchronised with the video bookmarks. They include a text overlay which provides supporting learning points from the video. The teacher can direct the students' attention to the main screen by switching the student display to standby mode.

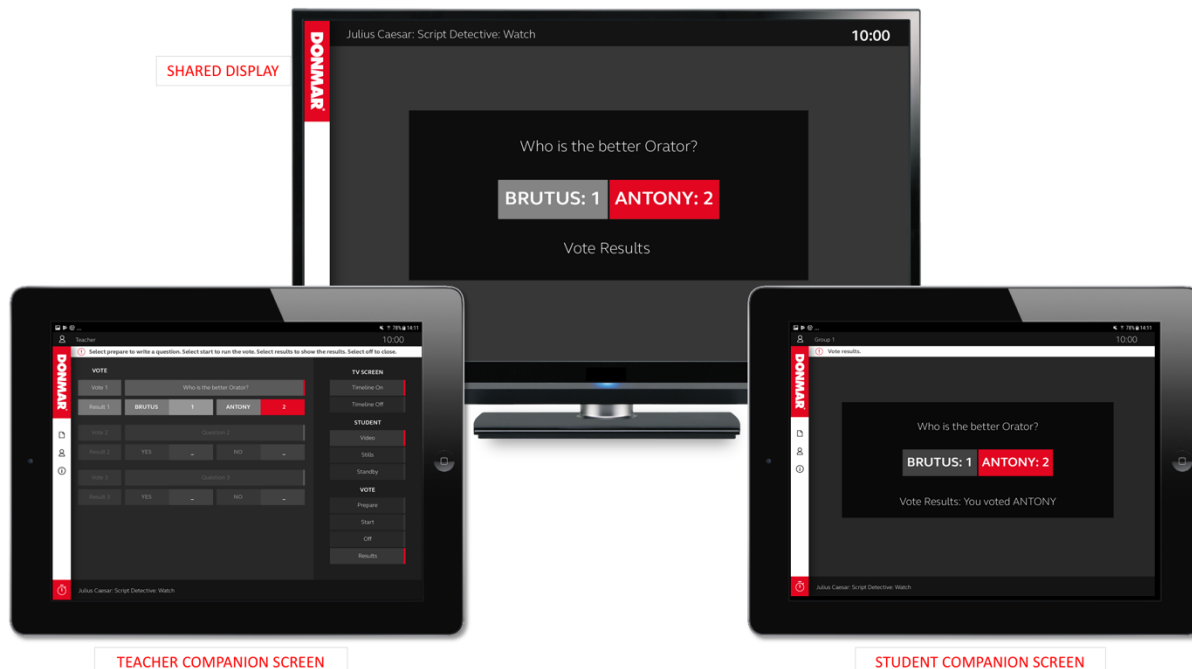


Figure 56 Watch Interface – Voting Display Results

The teacher can use the vote function to run quick polls with the class to stimulate debate and check for understanding, see Figure 56. The teacher can use the editable template to prepare three questions. Within the Script Detective a pre-prepared question was set, 'Who is the better orator?' with the answers options 'Brutus' or 'Antony' Figure 57. After starting a vote, the teacher is able to see how

many votes have been cast. The results are displayed on the shared display and student companion screens. Each group can see the vote results and their own answer, see Figure 58

5.7 Script Detective - Watch interface features

The Watch interface is manifest over three types of screens: the teacher's companion screen; the students' companion screens and the shared screen.

5.7.1 The teacher companion screen interface features

1. Media Panel
 - a. Video Player
 - i. Play and pause the video, timer display
 - ii. Play all or select specific bookmarks using the bookmark timeline
 - iii. Timeline highlights active bookmark
 - iv. Completed bookmark marked in grey until another selected
 - b. Information Panel
 - i. Displays learning content synchronised with the video
 - ii. Shows the plot point text and still image
 - iii. This is what the students will see when the teacher selects Stills display
 - c. Vote Panel – when Vote active
 - i. 3 vote panels
 - ii. Text input for questions
 - iii. Live data display
2. Display Controls:
 - a. TV Screen display controls
 - i. Show or hide bookmarks on the shared display
 - ii. Active bookmark is highlighted on share display timeline
 - b. Student Companion screen controls
 - i. Set the display to standby to direct attention to main screen
 - ii. Set the display to show synchronised video mirroring the main screen
 - iii. Set the display to show synchronised stills and learning points
 - c. Vote controls
 - i. Prepare a vote using one of three fields (text input)
 - ii. Start a vote – displayed on TV and student companion screens
 - iii. Monitor live vote progress – results are anonymous
 - iv. Display results of the vote on the TV and student companion screens

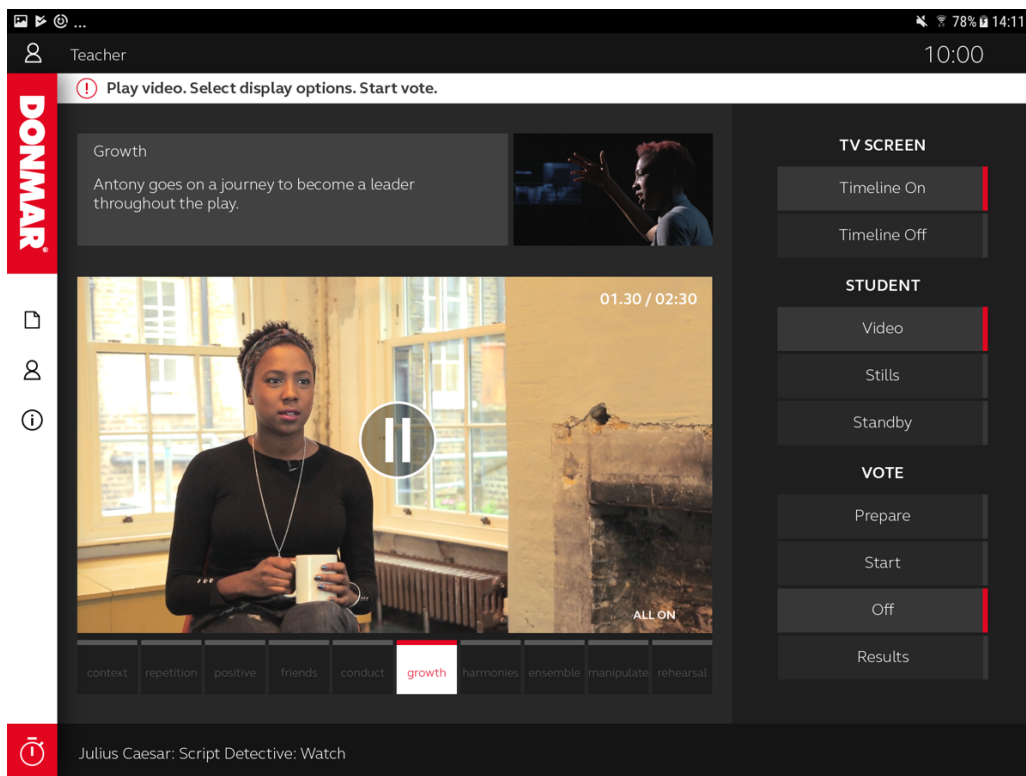


Figure 57 Watch - Teacher Companion Screen – Video

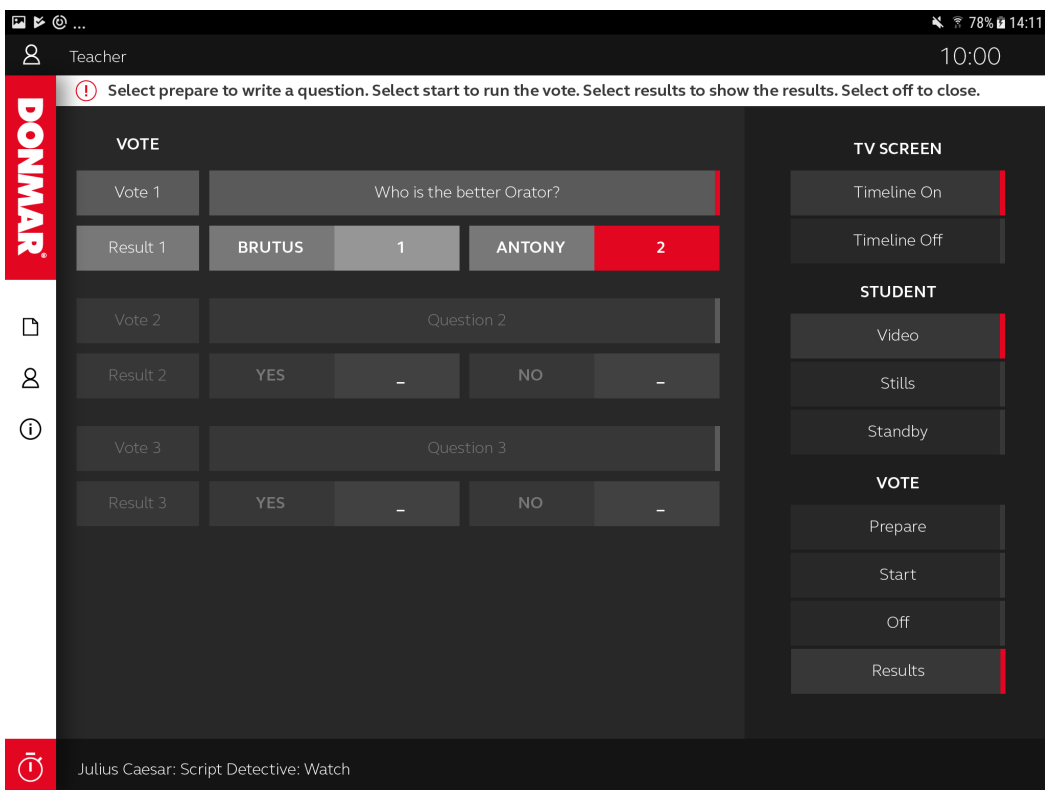


Figure 58 Watch - Teacher Companion Screen – Vote

5.7.2 The student companion screen interface features

1. Media Panel
 - a. Content viewer
 - i. Video with active bookmarks highlighted, see Figure 59
 - ii. Stills from the production with text overlays see Figure 60
 - iii. A standby image
 - b. Vote panel – when Vote Active
 - i. Cast a vote – stays active until vote closes, see Figure 61
 - ii. View vote results, see Figure 62

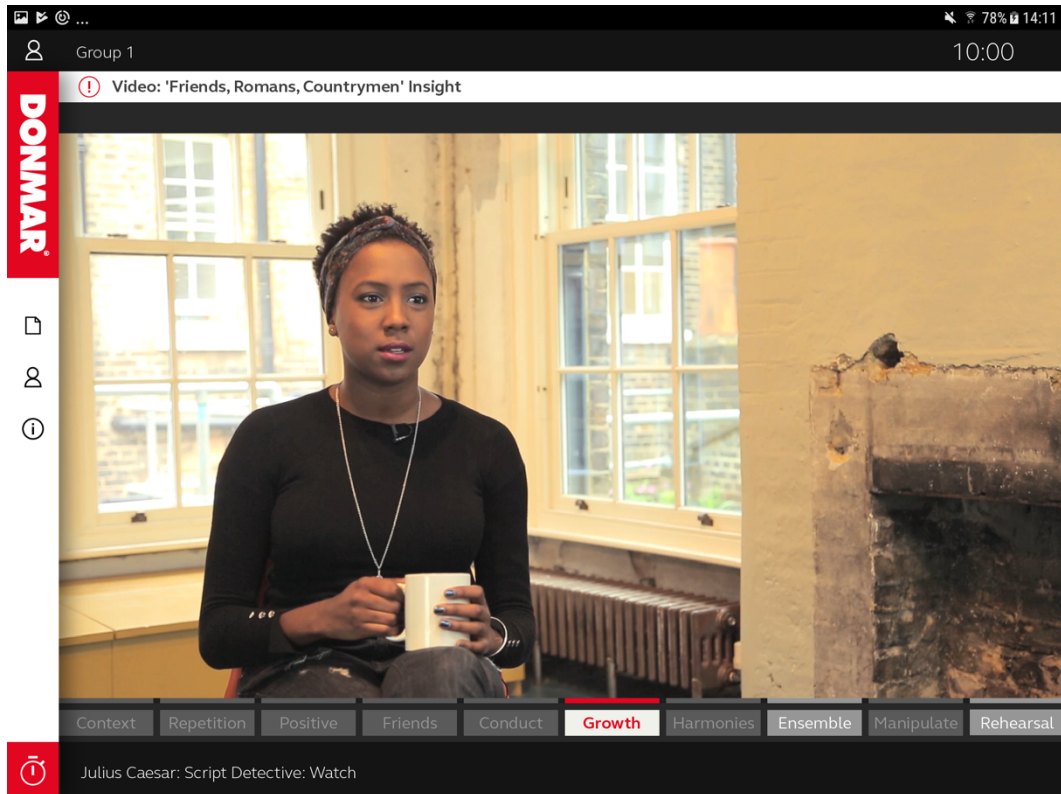


Figure 59 Watch - Student Companion Screen - Video

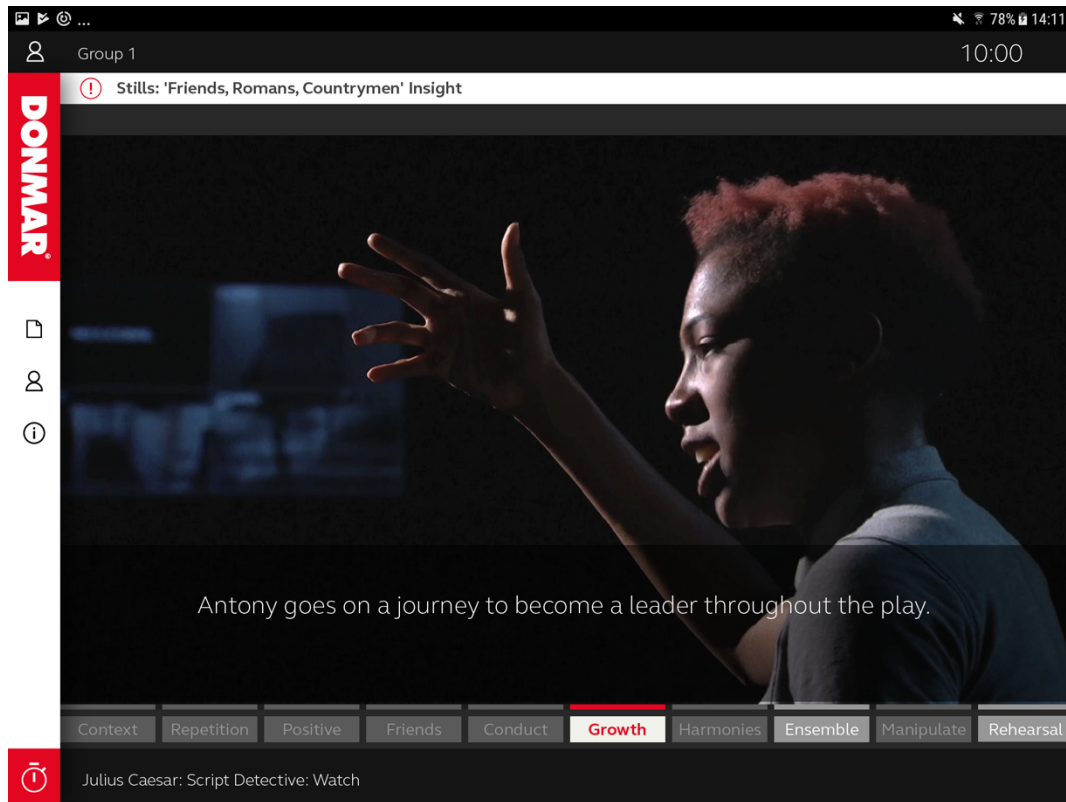


Figure 60 Watch - Student Companion Screen - Stills

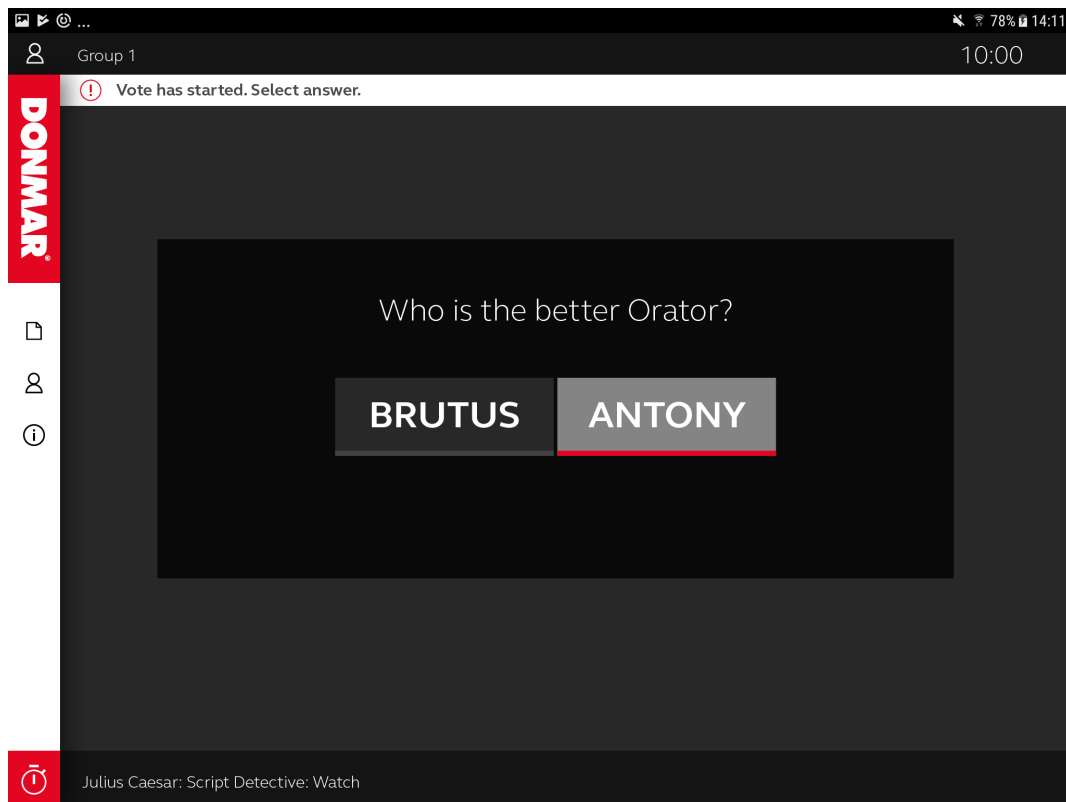


Figure 61 Watch - Student Companion Screen - Cast Vote

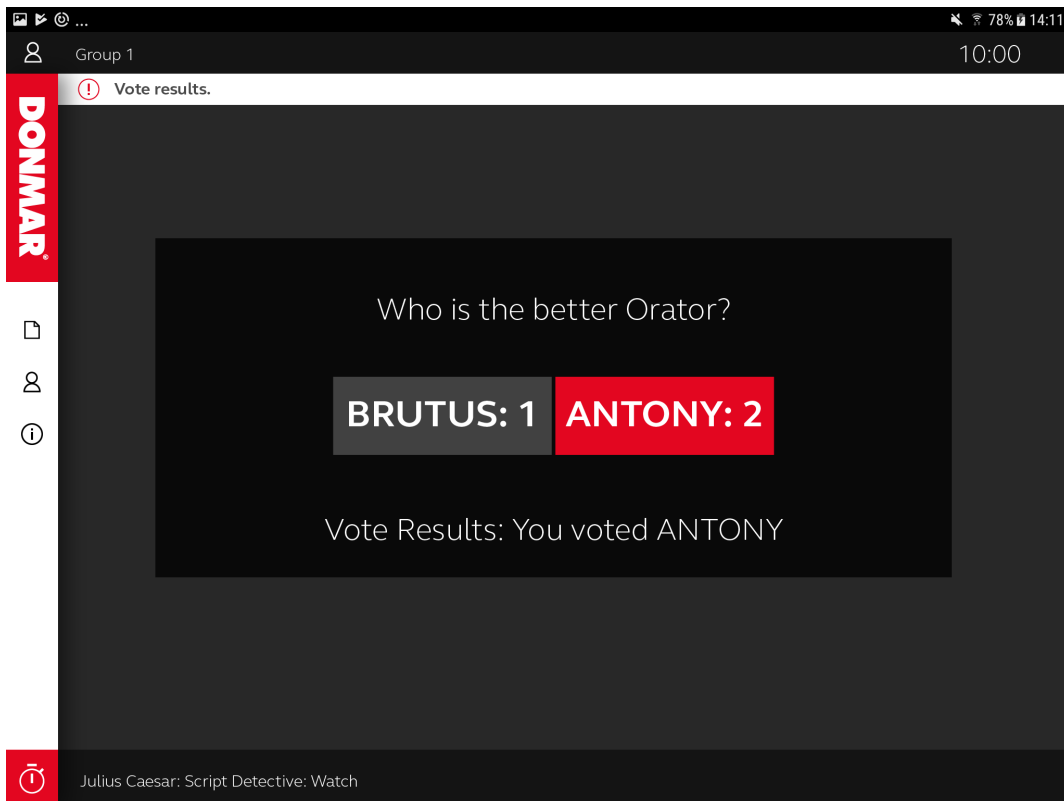


Figure 62 Watch - Student Companion Screen - Vote Results

5.7.3 The shared display (TV) interface features:

1. Video display
 - a. Timeline On /Off - Bookmark timeline across the bottom of the screen, see Figure 63
2. Media display
 - a. Vote question
 - b. Vote results, see Figure 64



Figure 63 Watch – Shared Display - Video - Timeline On

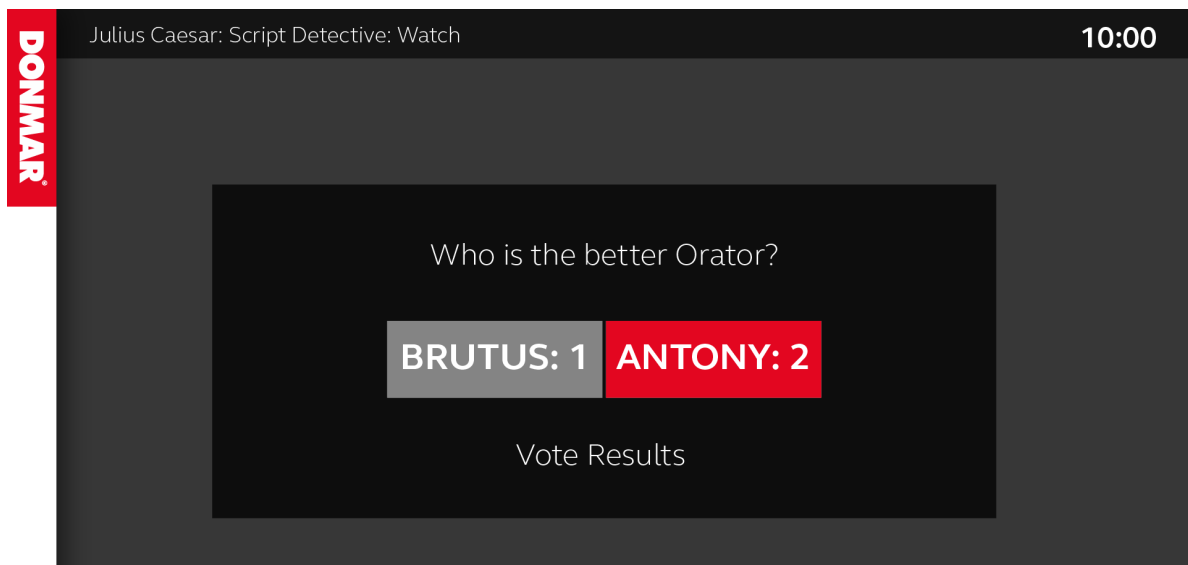


Figure 64 Watch – Shared Display - Media - Vote

5.8 Script Detective - Make - Overview

This section describes the Make portion of the Script Detective lesson.

The teacher starts Make and invites students to work on the group exercise. Using the shared display, the teacher can introduce the task and write messages using the whiteboard option. The teacher can set the student displays to standby to have their full attention. The teacher selects Script Detective to start the activity on the student companion screens. (see Figure 65)

The aim of the module is to discover which literary rhetorical devices are used in the speech to manipulate the crowd and create a temporal list of devices and emotional impact on the crowd that plays out on the shared display in Share. The speech is divided into 4 key sections, each containing 4

key clips from that section. Each group is allocated a section of the speech to analyse. The end result is an aggregated analysis of the speech created by the whole class.

A video player is populated with a playlist of 4 clips from the production linked to the selected speech segment. The students play each clip, featuring a text overlay with a hint about Mark Antony's intentions, and read the lines of script. There are three annotations to complete for each clip: identify keywords in the speech that use a literary device in their device option and write it in the text panel, select one device they think is being used from 4 available options and select an emotion they think Mark Antony is trying to make the crowd feel from a list of 6 emotions, see Figure 66. Groups can control their screen volume locally.

The teacher views the progress of each group in real-time using the group tab in the display panel. The teacher can see an overview of all groups in a visual chart. The chart displays the title of the selected speech clip, a device bar and emotion indicator highlight when students have annotated the clip. The teacher can view each group speech section as a set of four speech clip sections, featuring thumbnail images, script text, and all annotations. The teacher might use this to see which groups might need help or to discuss their choices, see Figure 67.

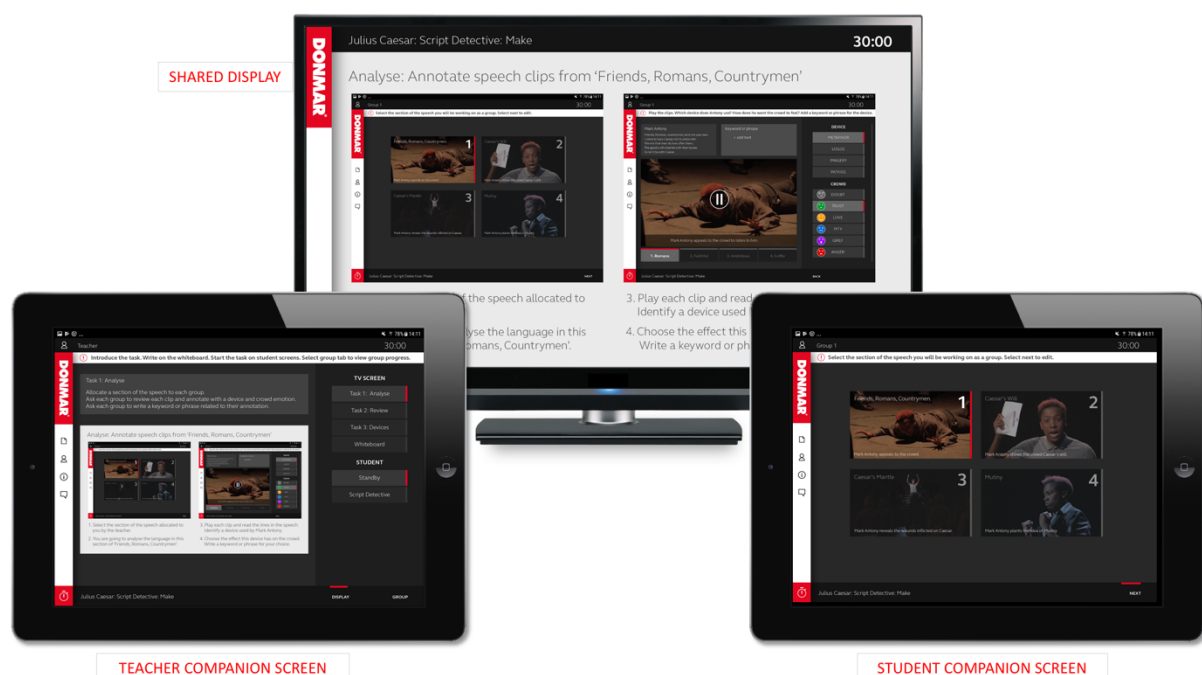


Figure 65 Make Interface – Teacher Instructions - Student Speech Selection

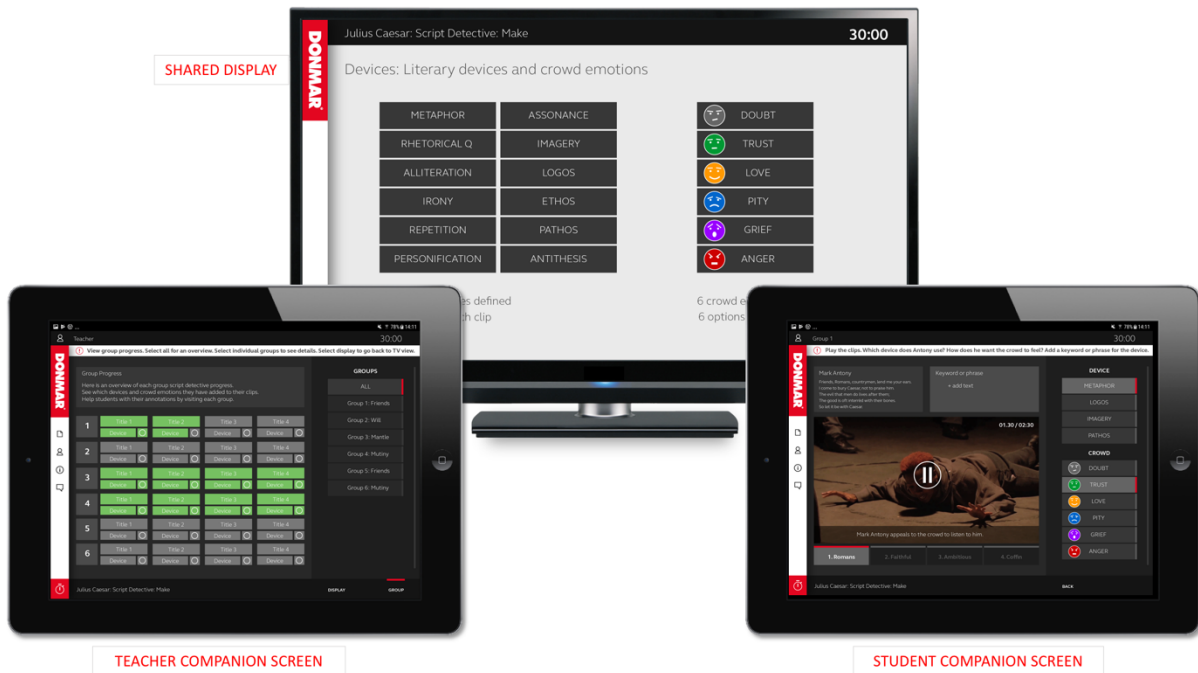


Figure 66 Make Interface – Teacher Group Overview - Student Speech Edit

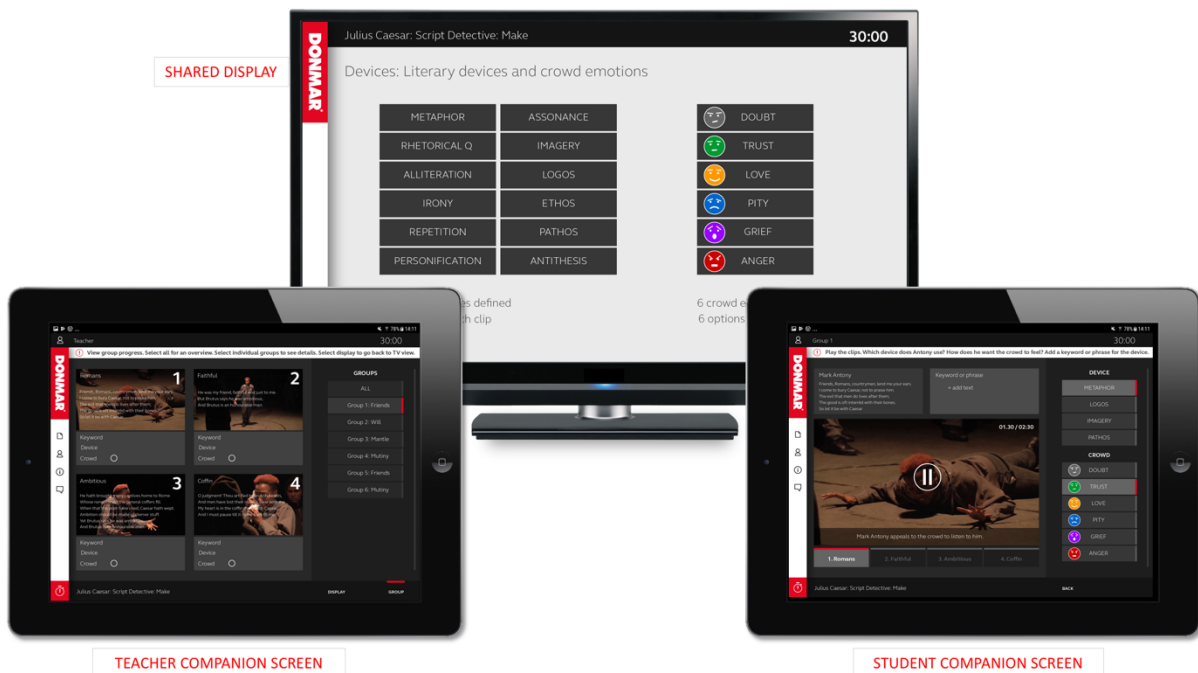


Figure 67 Make Interface – Teacher Single Group View - Student Edit

5.9 Make interface features

The overall Make interface for the script detective lesson is manifest over three screens: the teacher's companion screen; the students' companion screens and the shared display.

5.9.1 The teacher companion screen interface features

1. Media Panel
 - a. Share display preview
 - i. Information panel outlining current selection
 - ii. Task display selection preview
 - b. Whiteboard window
 - i. Information panel outlining current selection, see Figure 68
 - ii. Text input window – share on tv display when editing complete, see Figure 69
 - c. Group Progress window (ALL), see Figure 70
 - i. Information panel outlining current selection
 - ii. Progress panel - group plot point selections and annotation activity
 - d. Group Progress window (Selected Group)
 - i. Selected group 6 panel storyboard
 - ii. Text input from students for each panel, see Figure 71
2. Display Control Panel (tab selection):
 - a. TV Screen display controls
 - i. Task descriptions
 - ii. White board
 - b. Student display controls
 - i. Standby
 - ii. Script Detective
3. Group Progress Panel (tab selection):
 - a. Group selection options – section of speech added to group name
 - i. All groups - overview
 - ii. Individual groups - details

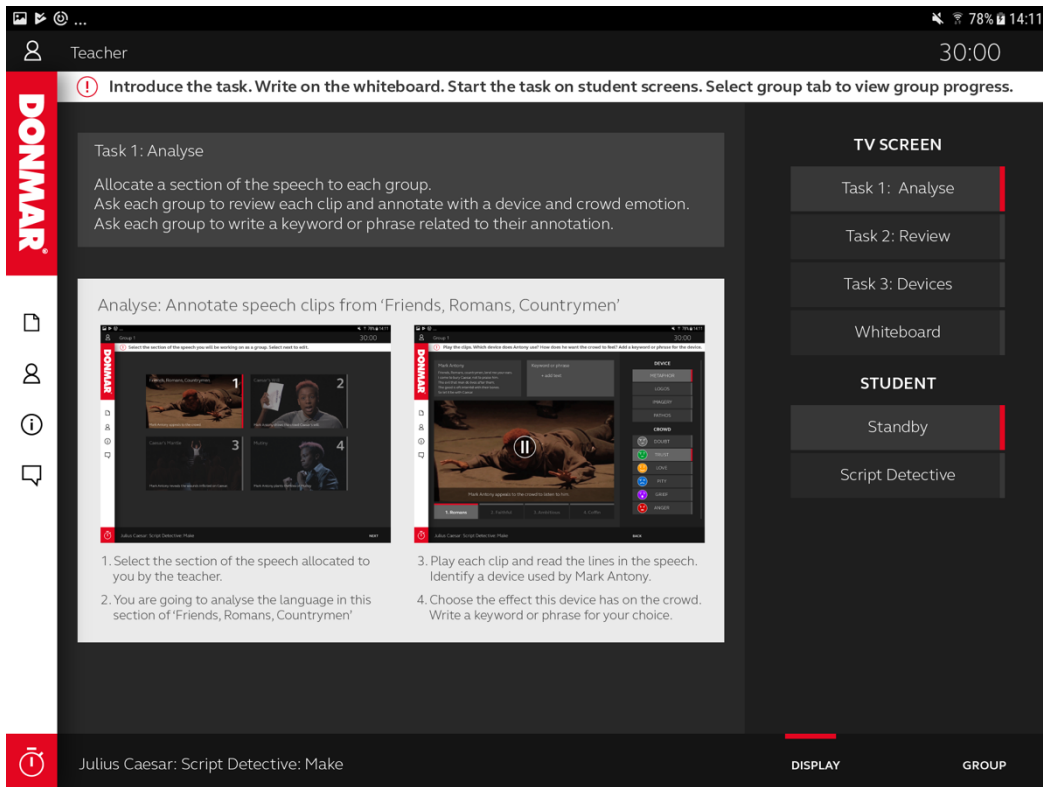


Figure 68 Make - Teacher Companion Screen – Task 1

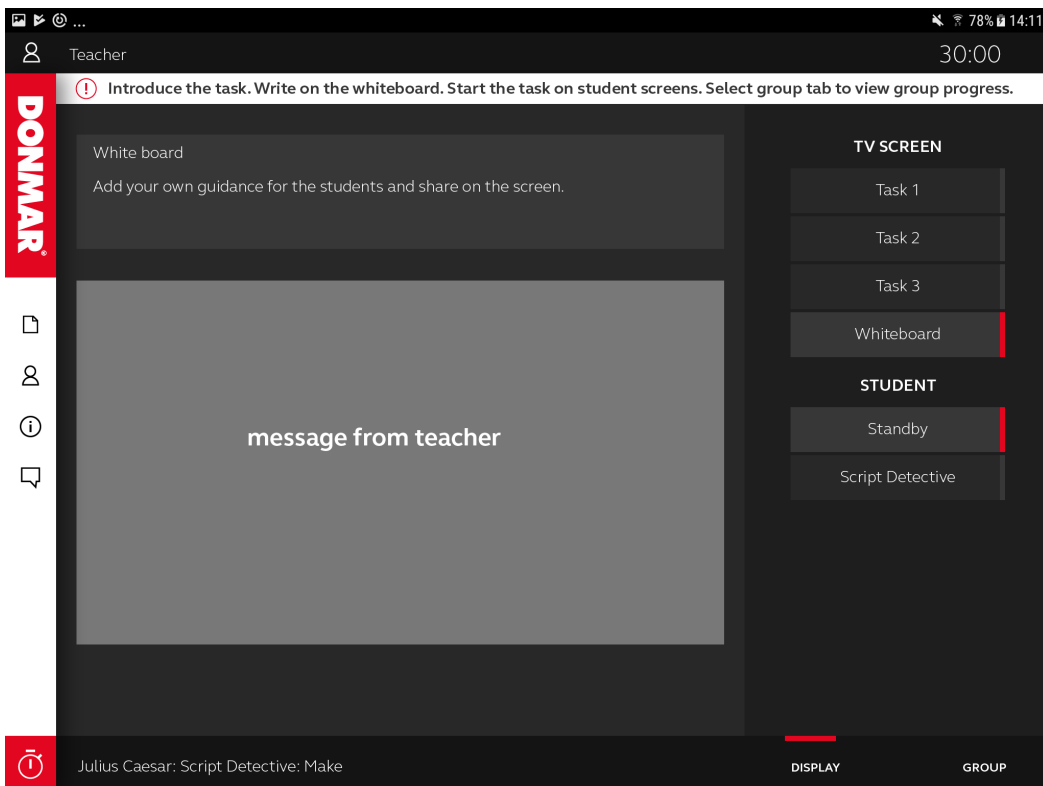


Figure 69 Make - Teacher Companion Screen - Whiteboard

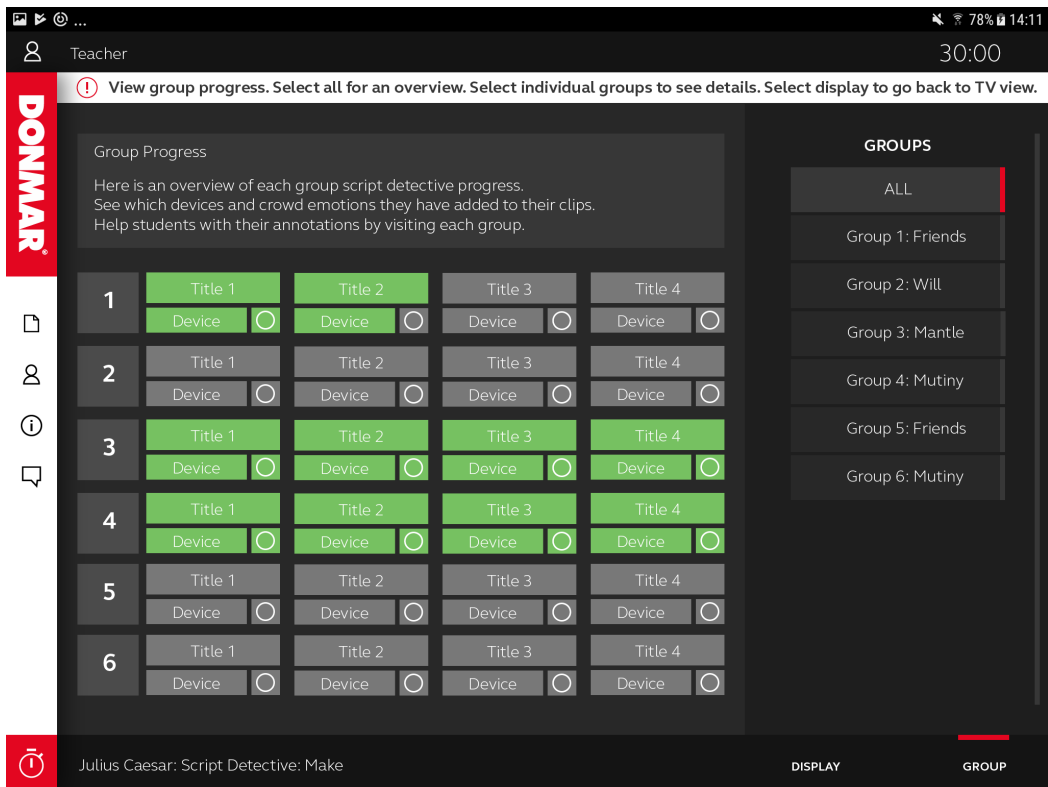


Figure 70 Make - Teacher Companion Screen – Group Progress All

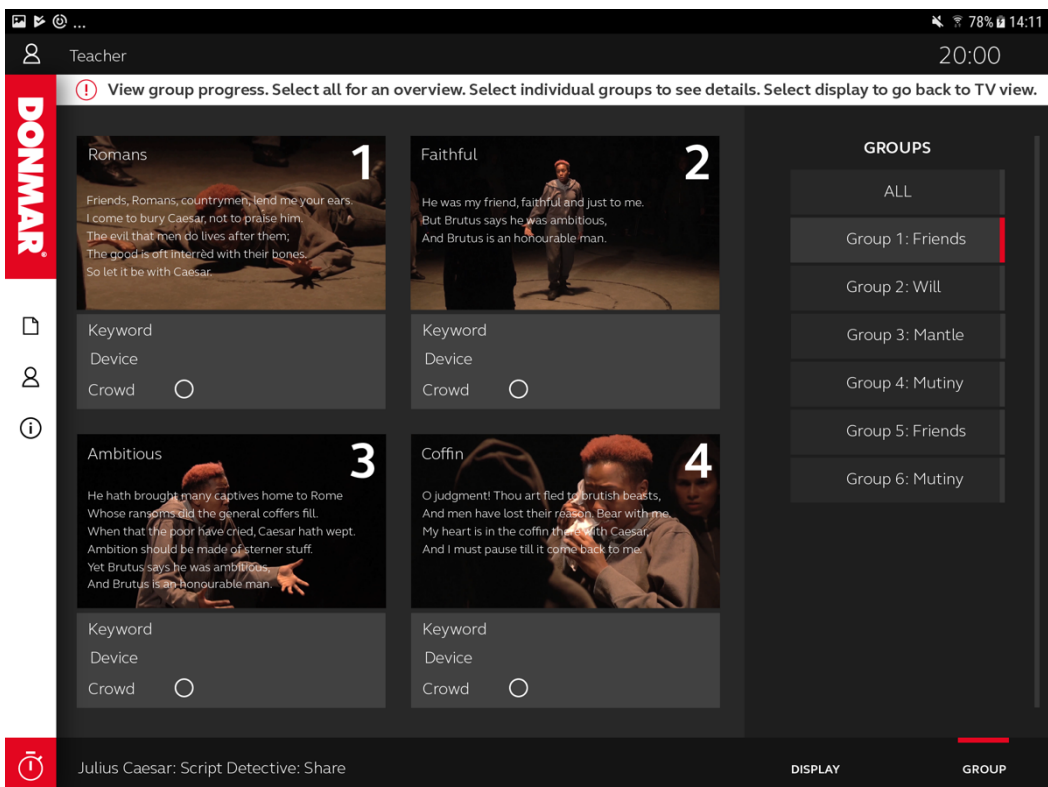


Figure 71 Make - Teacher Companion Screen – Group Progress Group 1

5.9.2 The student companion screen interface features

1. Media Panel – Speech select panel
 - a. Speech panel

- i. 4 speech sections with images and title, see Figure 72
2. Media Panel - Edit speech playlist, see Figure 73
 - a. Video Player
 - i. Play and pause individual bookmarks in playlist, timer display
 - b. Text Panels
 - i. Script panel displaying lines of speech from clip
 - ii. Text input panel for student to add keyword (tablet keyboard)
 - c. Selection Panel
 - i. 4 literary device options with radio button selection
 - ii. 6 emotion options with radio button selection

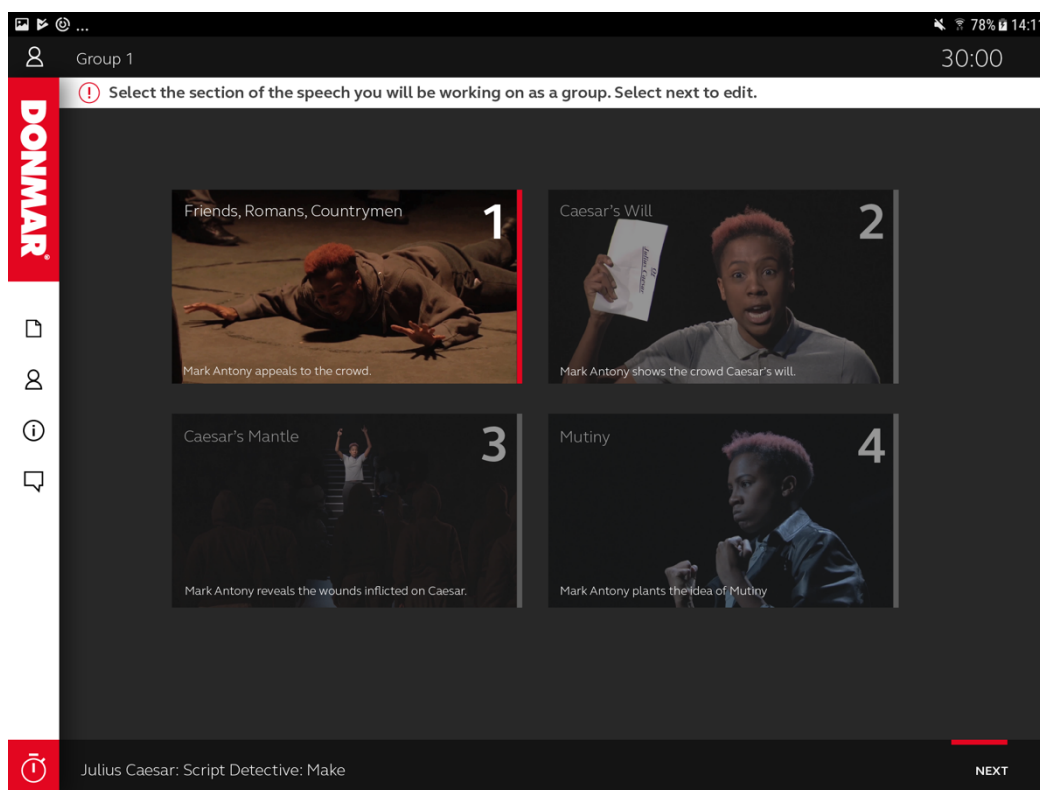


Figure 72 Make - Student Companion Screen – Speech Select

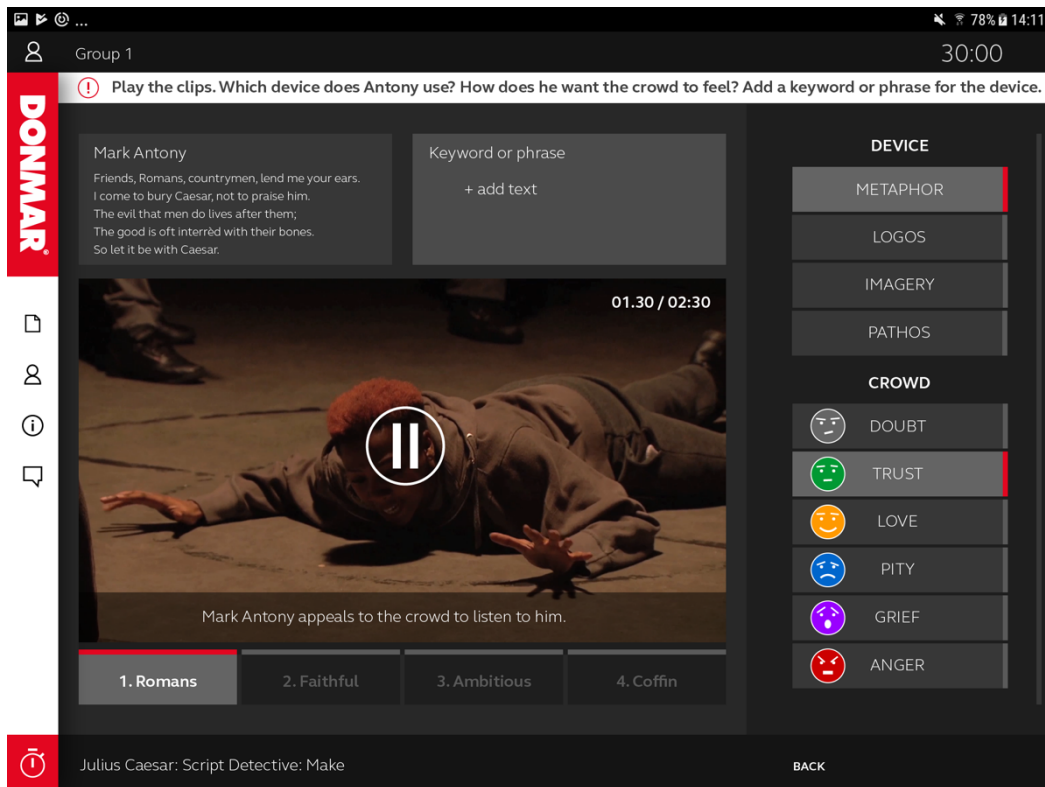


Figure 73 Make - Student Companion Screen – Speech Playlist Edit

5.9.3 The shared display (TV) interface features:

1. Media display
 - i. Task descriptions, see Figure 74 and Figure 75
 - ii. White board

Julius Caesar: Script Detective: Make 30:00

Analyse: Annotate speech clips from ‘Friends, Romans, Countrymen’

1. Select the section of the speech you will be working on as a group. Select next to edit.
2. You are going to analyse the language in this section of ‘Friends, Romans, Countrymen’.
3. Play each clip and read the lines in the speech. Identify a device used by Mark Antony.
4. Choose the effect this device has on the crowd. Write a keyword or phrase for your choice.

Figure 74 Make – Shared Display – Media - Task Description

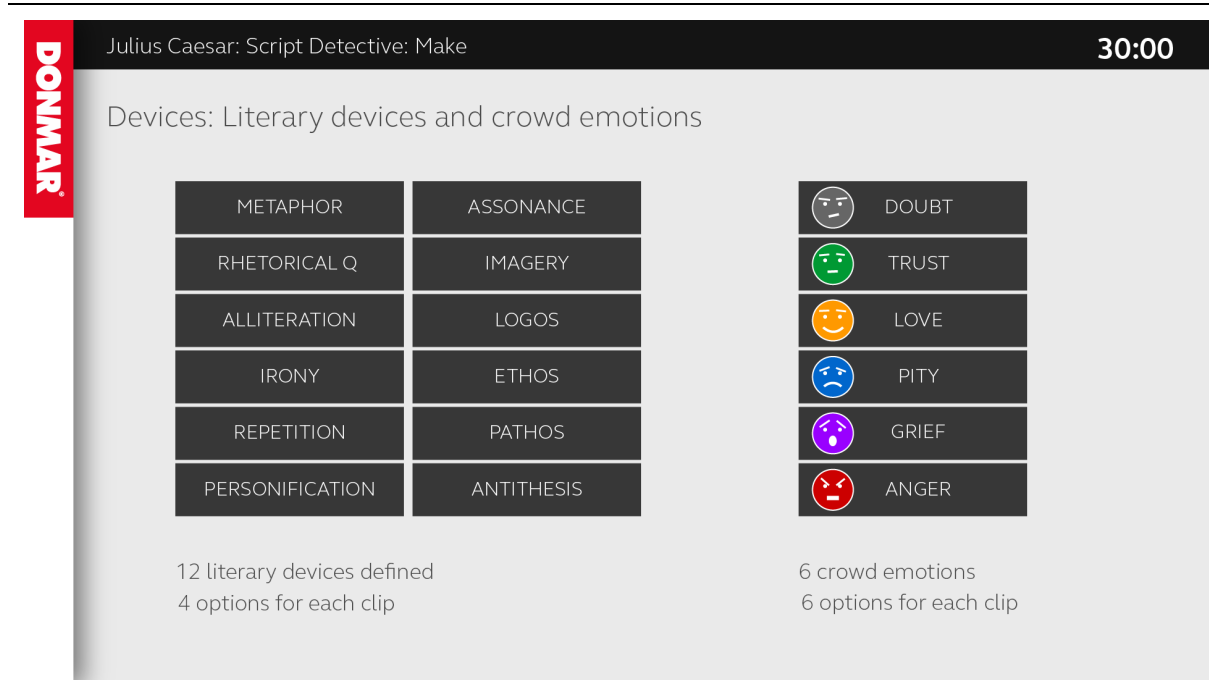


Figure 75 Make – Shared Display – Media – Devices and Emotions Reminder

5.10 Script Detective - Share - Overview

This section describes the final portion of the lesson, the Share section.

The teacher starts Share and invites the students to share annotated speech clips with the class. The shared display and all student displays are set to standby by default. There is the option to select the group tab to view group storyboards and the group progress chart. The volume level for all companion screens is automatically muted. There are two share options: individual group presentation as in Story Builder, or aggregated presentation of the whole speech.

In the first instance, when the teacher makes the shared display active the current selected group display is set to player mode. The group shares their speech clips and discuss their choices. The annotations on each clip appear as a text overlay on the shared display, see Figure 76. The keyword and device appear on the bottom of the screen, as a subtitle. As the clips play through each device and associated emotion moves to a new place in the right of the screen, creating a persistent temporal list. The bookmark timeline highlights the current clip playing and the title of the bookmark.

The teacher companion screen shows the video player, populated with the current group playlist. This provides the teacher with the option to take control at any time and pause the presentation to ask questions and encourage group discussion. The teacher can set the student displays to Standby, see Figure 77 or Viewer mode, see Figure 78.

To share the whole speech, the teacher selects 'All'. The video player switches into a different mode showing the titles of each speech section, and 4 highlight bars for each segment. As the video plays, and a key speech clip is active, a bar highlights and the annotations displayed. The key speech clips appear in specific places throughout the whole speech. The device annotations build a temporal list on the screen. The teacher can pause and review the speech and highlight patterns from the annotations with the students.

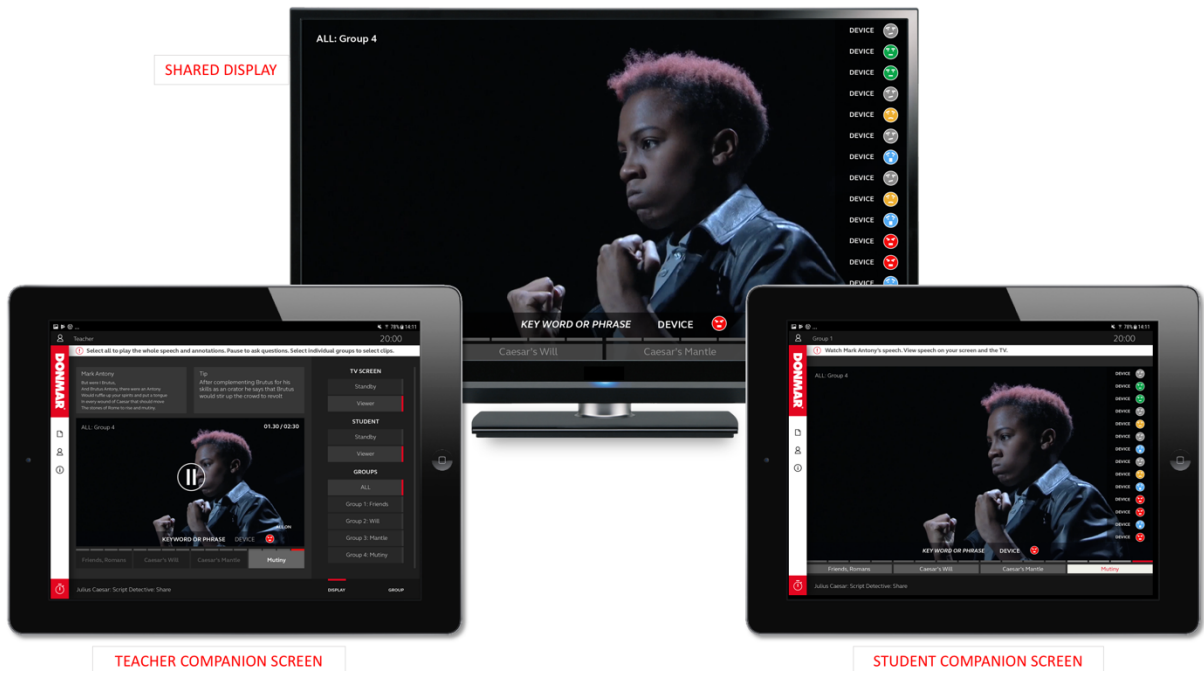


Figure 76 Share Interface – Teacher Select All – Aggregated Annotations

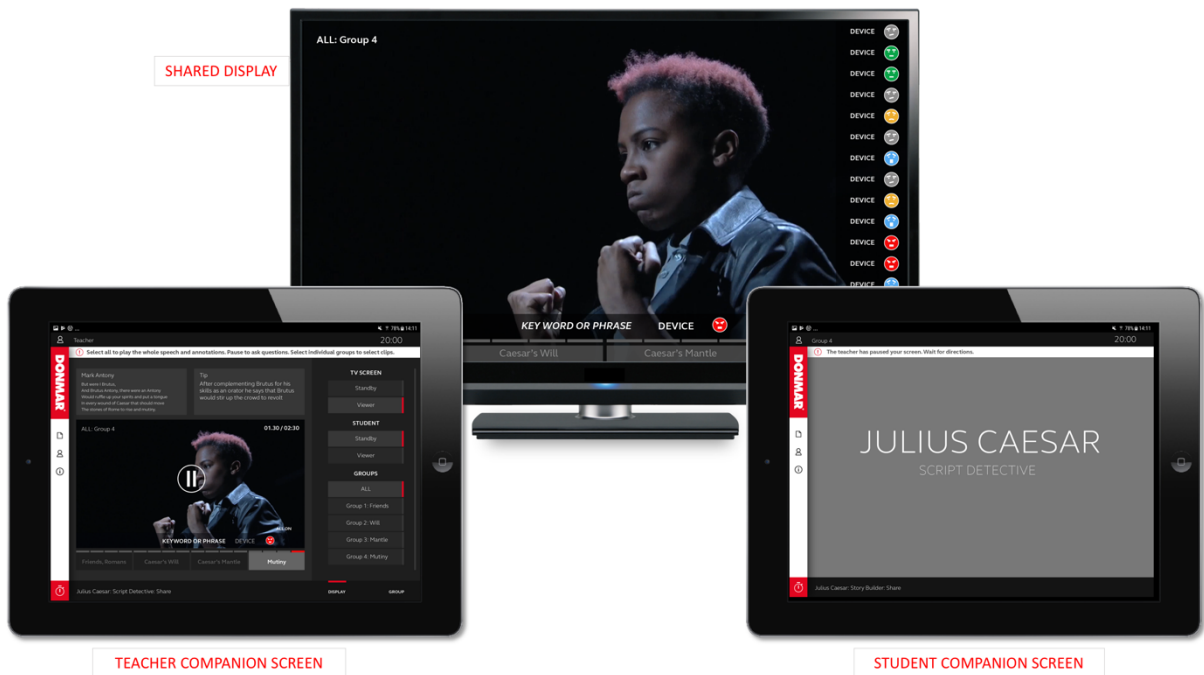


Figure 77 Share Interface – Teacher Select All – Student Standby

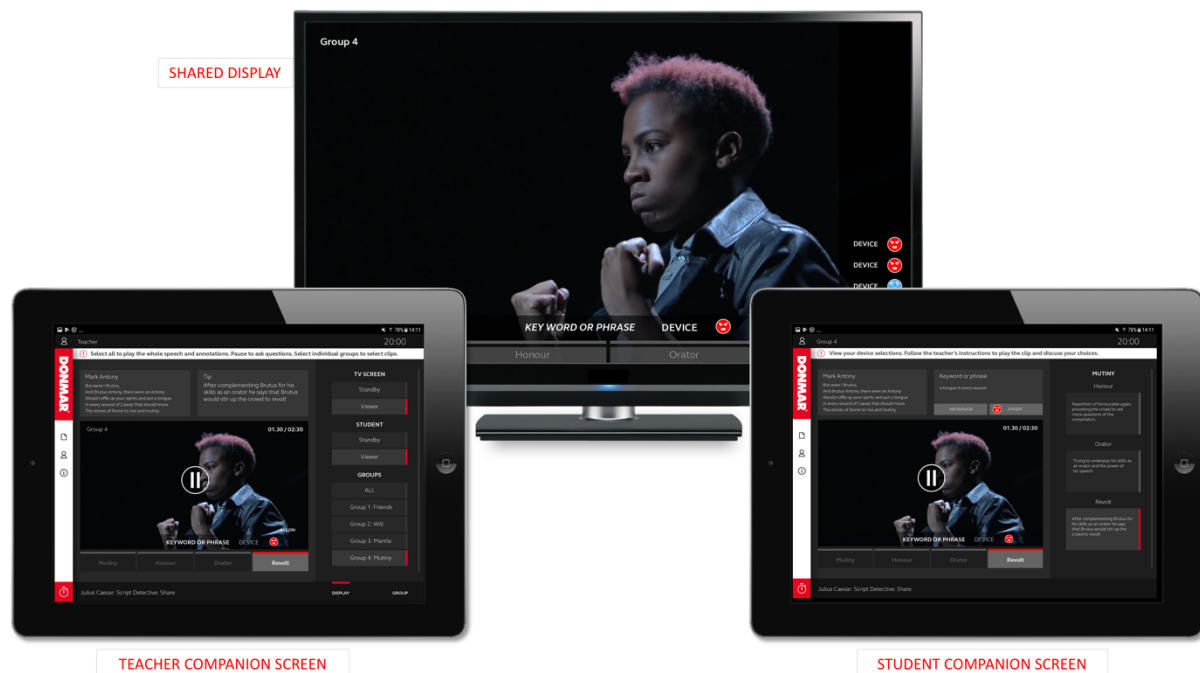


Figure 78 Share Interface – Teacher Select Group 4 - Student Group 4 Player

5.11 Share Interface features

The features of the share interface are manifest across three types of screens: the teacher’s companion screen; the students’ companion screens and the shared display.

5.11.1 The teacher companion screen interface features

1. Media Panel
 - a. Video Player - All, see Figure 79
 - i. Play whole video or speech segment to play and pause, timer display
 - ii. Timeline highlights active speech segment, and speech clip
 - iii. Text overlay displaying keyword device and emotion, group ID
 - b. Video Player - Group
 - i. Play and pause specific speech bookmark, view time of each bookmark, see Figure 80
 - ii. Timeline highlights active speech clip playing
 - iii. Text overlay displaying keyword device and emotion, group ID
 - c. Text Panels
 - i. Speech script panel displaying script lines from clip
 - ii. Tip panel displaying the tip about the clip
 - d. Group selector
 - i. Select All – switch player type to all
 - ii. Select Group – group identifiers and speech segment title
2. Display Control Panel (tab selection):
 - a. TV Screen display controls
 - i. Standby – overrides all screens to standby
 - ii. Viewer – shows group selection, enables student display selection
 - b. Student display controls
 - i. Standby – student displays set to standby, selected group player
 - ii. Viewer – student displays set to viewer, selected group player
3. Group Progress Panel (tab selection):

- a. Group selection options
 - i. All groups - overview
 - ii. Individual groups – details

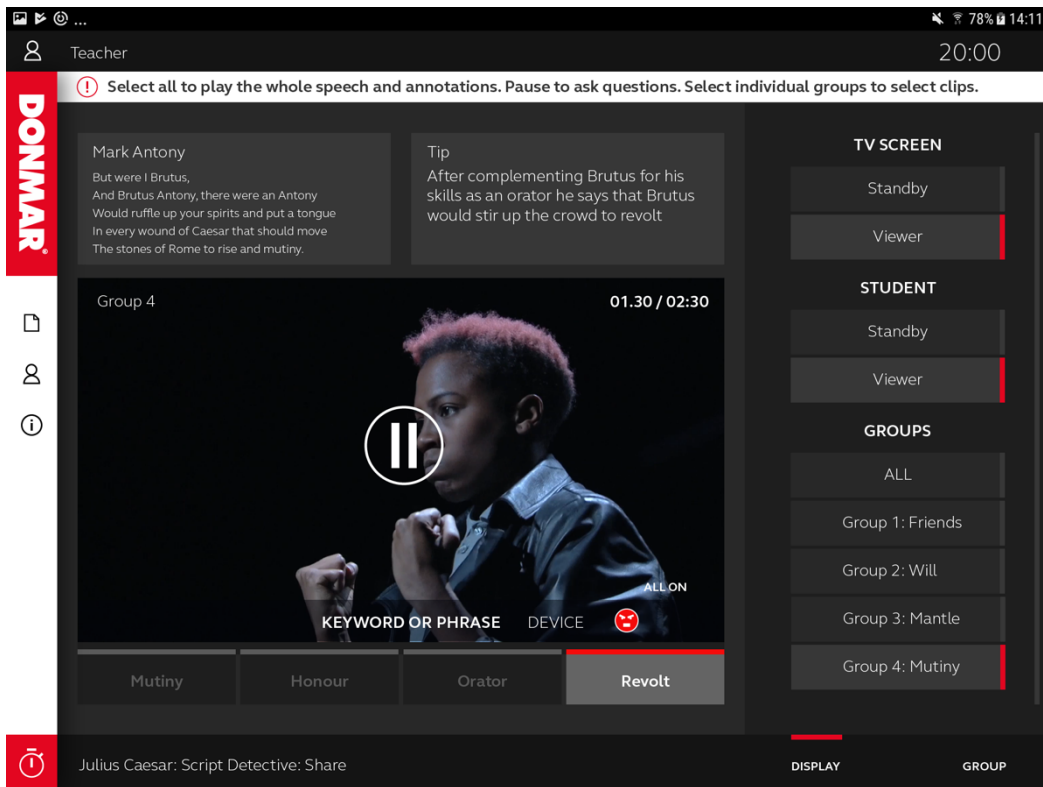


Figure 79 Share - Teacher Companion Screen – Group 4 Selected

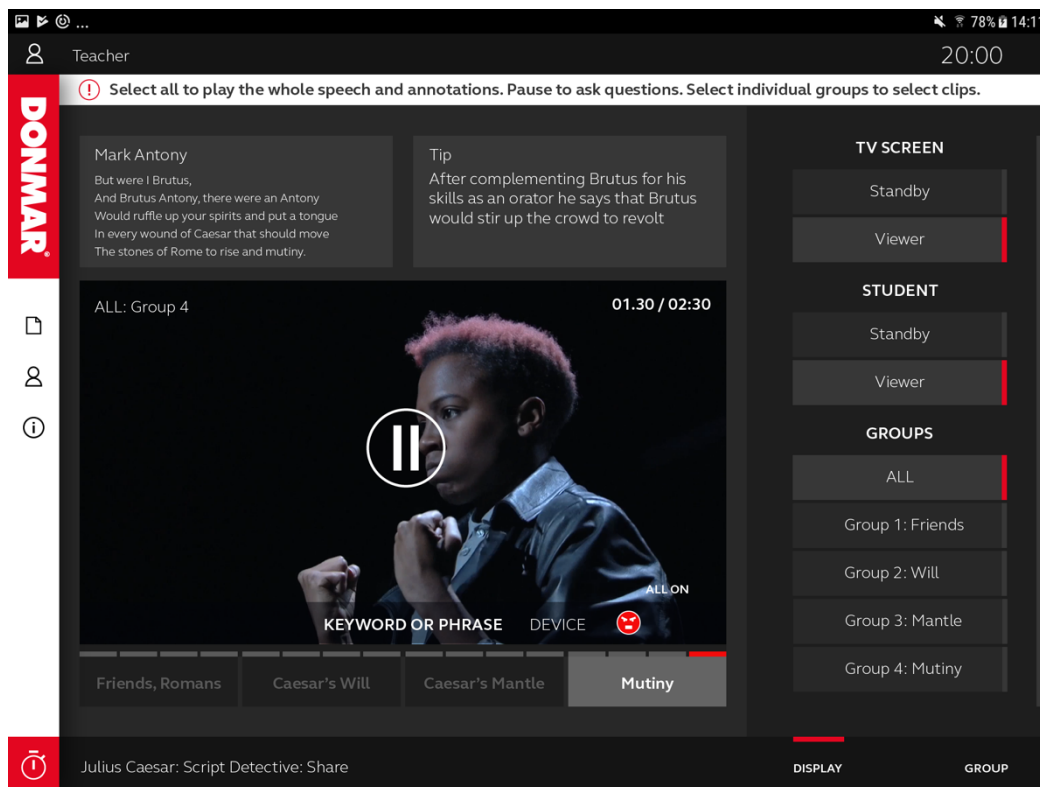


Figure 80 Share - Teacher Companion Screen – All Selected

5.11.2 The student companion screen interface features

1. Media Panel -Viewer
 - a. Video viewer, see Figure 81
 - i. Video with active bookmarks highlighted (All or Group timeline)
 - ii. Overlays – keyword, device, emotion, group ID + temporal device list
2. Media Panel - Player
 - a. Video Player
 - i. Play and pause individual bookmarks in playlist, timer display
 - ii. Text overlay displaying keyword device and emotion/ or tip, see Figure 82
 - b. Text Panels
 - i. Speech script panel displaying script lines from clip
 - ii. Annotation panel displaying keyword device and emotion
 - iii. Scrollable list of story speech clips, select bookmarks from list

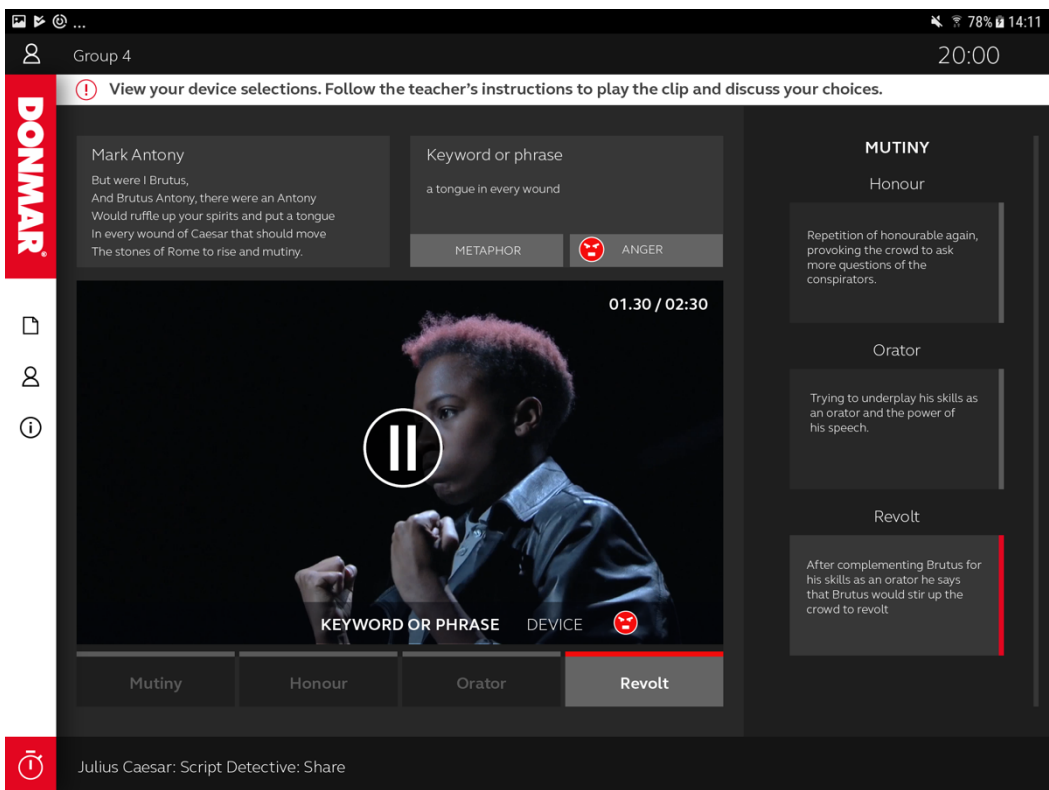


Figure 81 Share - Student Companion Screen – Group 4 Selected - Player

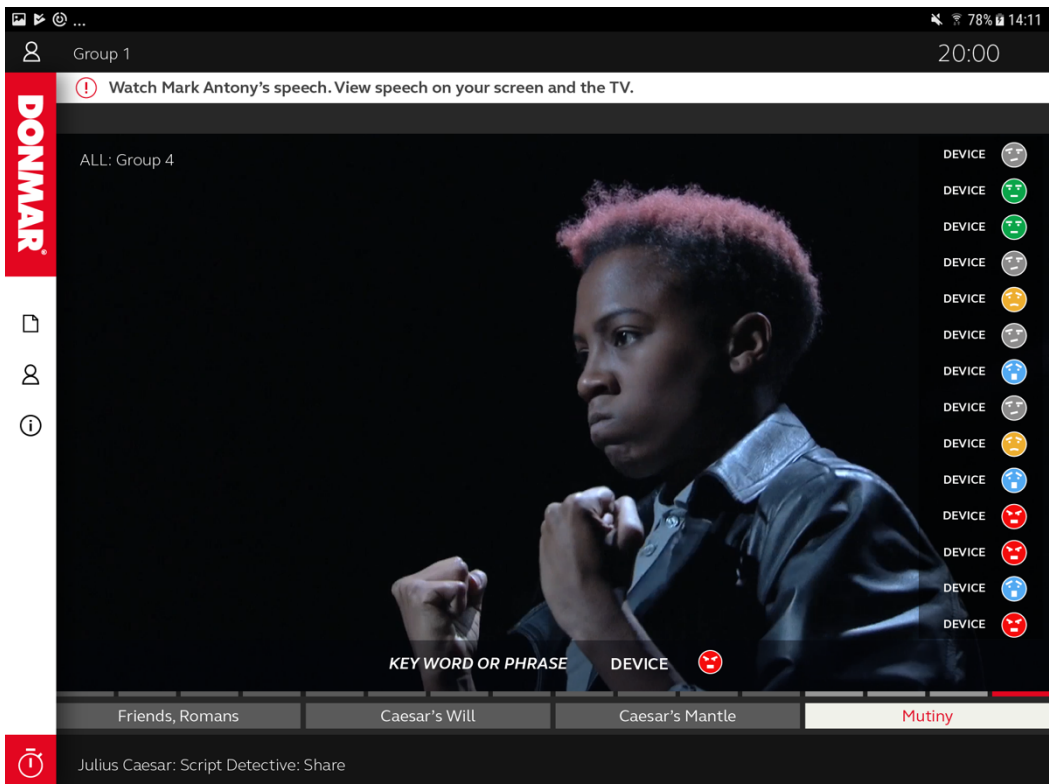


Figure 82 Share - Student Companion Screen — All Selected – Player

5.11.3 The shared display (TV) interface features

1. Video display,
 - a. Selected group, see Figure 83 or whole video, see Figure 84
 - b. Overlays - keyword device and emotion, group ID, temporal device list
 - c. Bookmark timeline across the bottom of the screen (All or Group timeline)

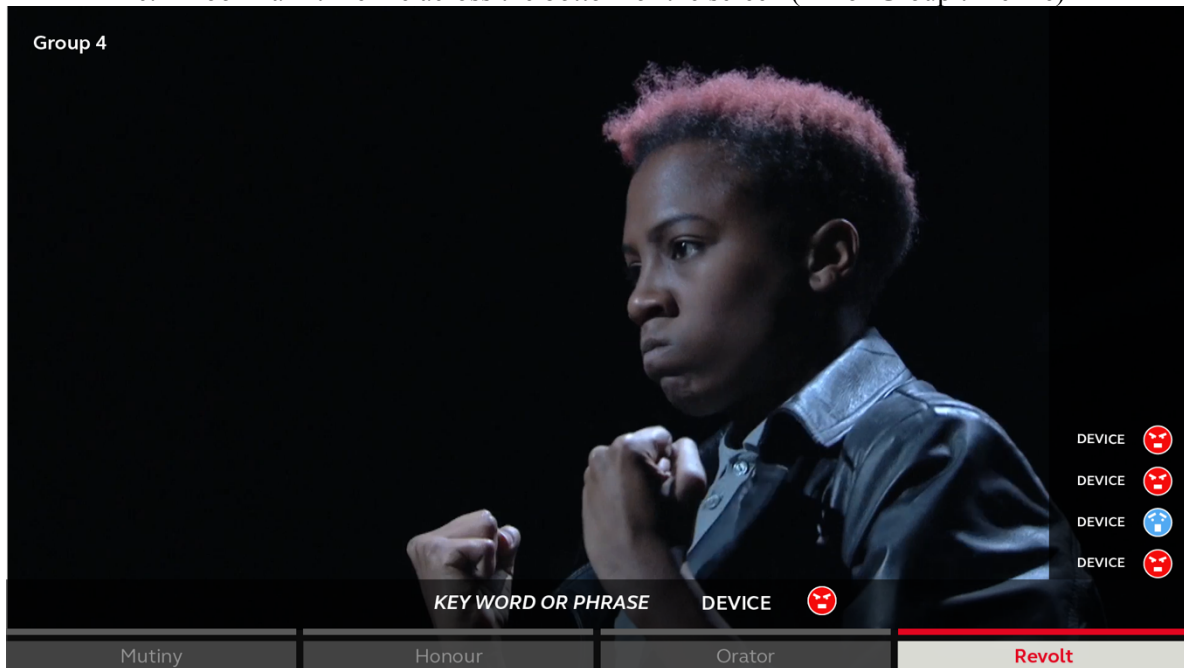


Figure 83 Share – Shared Display – Group 4 Selected – Video – Group List

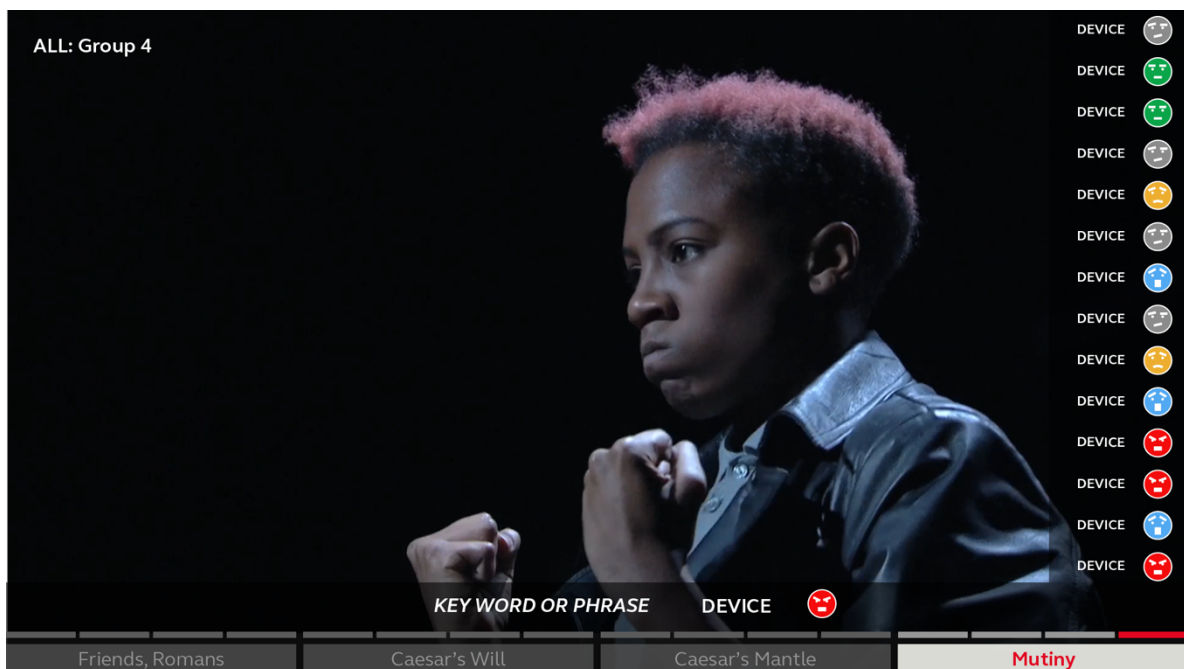


Figure 84 Share – Shared Display – All Selected – Video – Temporal List

6 New Service Prototype Development - Summary

By creating two modules for the *Theatre in Schools* prototype we were able to demonstrate a framework that could support different types of learning content and group activity within a common structure.

The two lessons we created were used and evaluated in schools in London and Suffolk. This experience provided useful feedback and helps to evaluate some of the design approaches we had adopted during the development of the lesson ideas. It also provided useful insights from both teachers and students and the Donmar Warehouse. This evaluation process and the results from it are reported in D4.7.

We have also developed demonstrated re-use of existing capabilities of the 2-IMMERSE platform and the generation of some new capabilities.

6.1 Existing capabilities:

- Object based graphics and audio:
 - Content mark-up and display rules were defined using a master template document for the module content.
- Synchronised content:
 - Video, graphics, audio, data were synchronised in the different modes.
- Multi-screen experience:
 - A shared display, teacher companion screen and student companion screens.

6.2 New capabilities:

- Content Browser
 - A content browser to support media display, user-input and interaction with video and text. The browser was personalised for teacher and student roles.
- Bookmark timeline
 - A bookmark timeline feature to play and pause all bookmarks, individual bookmarks, and segmented bookmarks (grouped sections of a video).
- User Annotation
 - Three types of user annotation; free-text, icons and pre-defined text options.
- Aggregated Live Interactions and Inputs
 - Live participation and content aggregation in the vote capability.
 - A live teacher view of student progress.
 - Two share modes in which we could share and display both individual and aggregated group playlists and annotations.
 - Two methods for creating video playlists, selecting from an open list, or from a pre-set selection.
- Audio Management
 - Companion screens to mute in the Watch and Share modes to avoid conflict with the volume on the shared display.
 - Local control of the companion screens volume in Make.
- Orchestration of User Attention
 - Display controls her to direct student attention to the main screen or presenter.
- Branching timeline
 - Three interaction modes in the lesson timeline; Watch, Make and Share.

6.3 Longer term aims or objectives that could not be realised during the project

Here we summarise some longer term ideas and ‘wish-list’ items for the *Theatre in Schools* service trial, from the Donmar’s perspective:

1. The idea that teachers could edit and customised a module

- Adding own content
- Supporting differentiation
- Editing tasks
- Personalising lesson plans

This is important because the prototype was designed with the view that all content, in the longer term, could be edited, customised or replaced with new content and a customisation interface could be built on top of the content mark-up document we developed for the prototype.

2. Use generated content

- Recording audio
- Filming tasks
- Sharing videos
- Longer form writing

User Generated Content was vetoed on technical and GDPR reasons except for recording audio but there was no time to develop it.

3. Sustainability

- Saving student material
- Saving individual contributions
- Picking up for another lesson
- Revision

This was out of scope of the project goals.

4. Checking for understanding

- Questions – exam type questions
- Student feedback
- Recording achievements
- Teacher notes

Also out of scope of the project goals.

7 **UX principles and recommendations for the development of multi-screen object-based experiences**

This section is a summary of UX design principles developed through the service trials.

UX design principles are a set of rules that guide decisions that define and maintain the project. They identify and meet the needs of everyone involved, from the creators to the audience. UX design principles are used to determine which solution is the most appropriate, and they can help explain and defend design rationale.

UX design principles work at a higher level than specific UX design guidelines or features, which work at a lower level (such as defining the design of a pop-up menu, or defining which size and colour of font to use).

7.1 **Principles: the origin of principles, principle sources and groups.**

Principles are derived from many places. They may be derived from the aims and objectives of a project brief, they may be applied-by or required-by those involved in the distribution, design and development, and consumption of an experience. Principles might evolve from a set of technical abilities or constraints.

The origins of UX-principles that developed during the 2-IMMERSE project came from a variety of sources or groups. Below is a description of those sources and groups, and how the principles emerged from them:

7.1.1 **Principles related to scope and resource**

The project had a clear scope. The project was exploring the hypothesis that multiple- screen experiences based on the delivery of object-based media could provide users with a better experience than they could enjoy using linear media and a single screen. Thus, designs were obliged to respond to this challenge to deliver experiences across multiple screens and to enable them to be evaluated next to their single screen alternatives.

The project was ambitious and innovative; but it also had to deliver and all design ideas had to be completed within the scope of the overall project and of other concepts and research avenues that the project also sought to explore. So the management of resource (time money or particular skills) sometimes became a principle that guided UX design choices

Lightfield technologies, for example, may (eventually) yield some interesting concepts but were deemed not viable within the available resources. Similarly many design concepts, particularly those in the early stage of the project were not viable given the maturity and complexity of the 2-IMMERSE platform at that stage in the project. For example, as the *Theatre at Home* service prototype was being developed, the 2-IMMERSE platform was in the early stages of development. The design imagined reconfigurable layouts with the option to select where content (the text chat window for example) should appear (the designers imagined the option to place the script on the mobile phone would be available, see Figure 85, lower image). The capability, giving users the ability to decide where to place a particular content object, was not yet enabled on the platform and enabling it would have delayed the appearance of the Theatre At Home service prototype. To address this, and to better manage the resource, the UX design choice was made to make the text chat window available throughout the experience on the shared TV screen (See Figure 85 upper image).

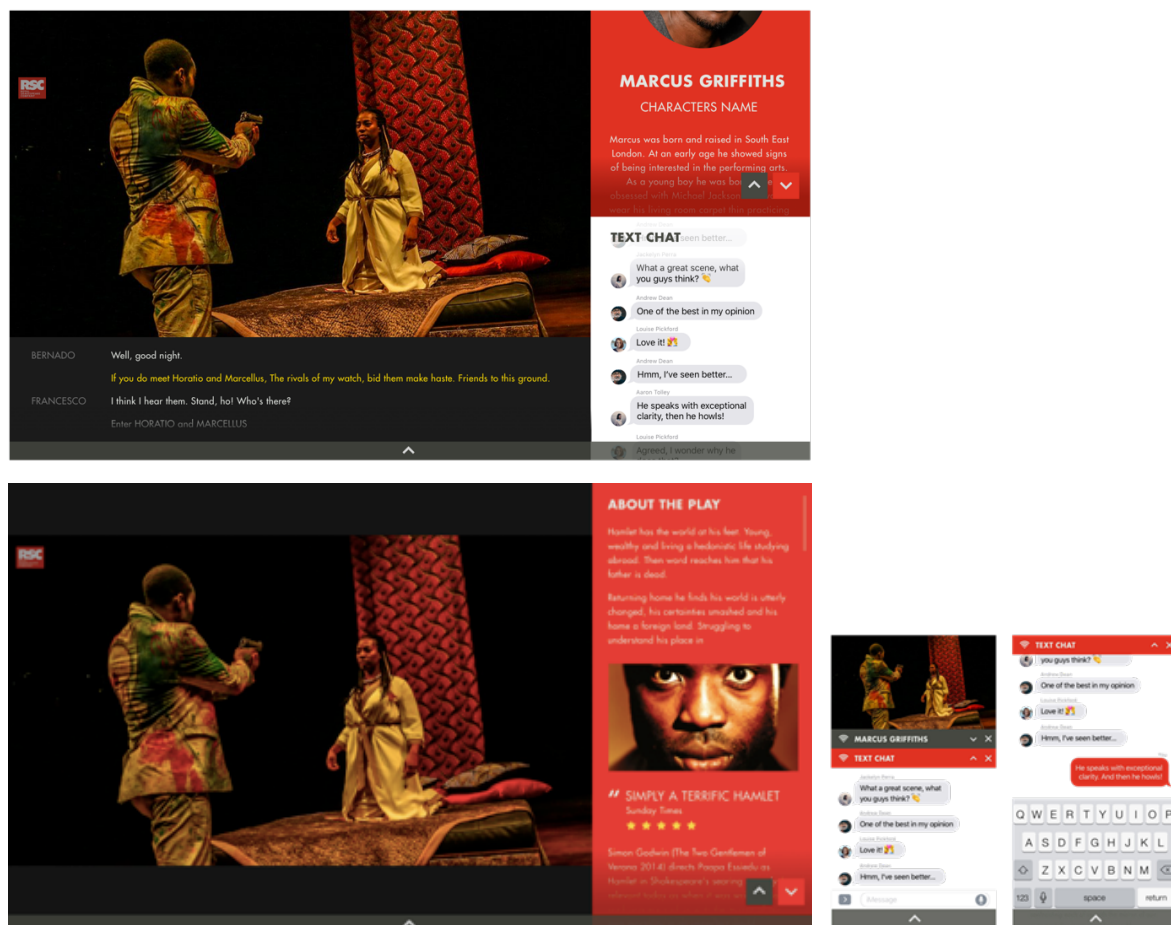


Figure 85 Original UX-designs for *Theatre at Home*, explored the shared TV screen with text chat window (upper image) and without a text chat window (lower image).

7.1.2 Principles related to Producer goals

The project developed strong relationships with rights holders for the content (Donmar Warehouse, BT Sport, Dorna Sports etc.) and, on principle, sought to respect and be sympathetic to the goals of the rights holder. Thus we sought to mirror look and feel and brand identities and to present concepts that made sense within the commercial models that rights holders could conceive as being viable.

Some UX design options may look viable, sensible or fun for a user (complete control of the shot selection for example) but in this hierarchy such ambition would be trumped by the Producers goals, which included maintaining their strong aesthetic in order to represent the core content (the performance, the race, the match etc.) in line with their purpose and brand. For BT Sport the ambition is to take user ‘closer to the heart of sport’, for the RSC the performance, the whole performance, is paramount and a key objective for them is to introduce people to complete performances of Shakespeare.

Examples of design principles relating to producers also include the adoption of branding, templates, and ‘safe-areas’ that were part of the design language and identity of the producer. These constraints had an impact on the UX-design and become principles, applied through design guidelines. Figure 86 shows the graphic regions defined by BT Sport and Dorna. The definition of these regions helps the overall aesthetic for TV; it helps cameraman frame their shots in ways that will avoid key action being obscured by graphics, such as brand graphics for BT Sport and the MotoGP logo. It also helps users as they will learn what information is where. This same layout can be replicated in an object based delivery world allowing us to closely replicate the look and feel of today’s composited sports

presentations which typically burn-in the graphics to the video before they leave the outside broadcast truck.

In *Football at Home*, the BT Sport COO stated that the directors-mix video stream should ‘*always be present*’, picture-in-picture (PiP) views could only appear in the top left and top right of the screen, and that the graphics were arranged left to right in terms of team layout.

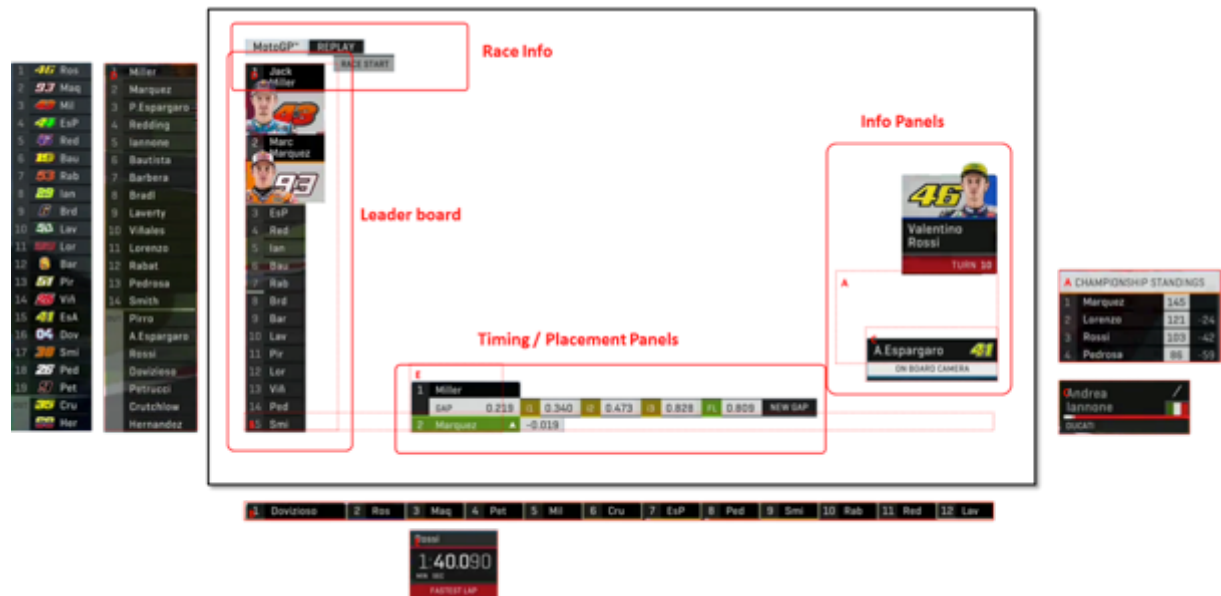


Figure 86 *MotoGP* graphic regions defined by BT Sport and Dorna.

Content owner and producer principles were applied in the 2-IMMERSE use cases. For example, for *Theatre At Home*, the Royal Shakespeare Company, as the content provider wanted the video of the play to appear unencumbered on the screen. They would not countenance overlaying the video of the performance with the synchronised script, instead, the script was displayed in a separate window, beneath the video window (see upper image in Figure 85). We suspect that this principle disrupted the ease with which some trial participants could read the script while watching the play, but cannot verify this as we could not test this alternate option (any desire to do so was trumped by the principle of tractability.)

7.1.3 Principles related to the role of the Director

The service prototypes need someone to direct them; in schools this is the teacher, in public spaces it would be the venue manager, in *MotoGP* it would be the race director. Each enables certain choices and options for the end user (the viewer/the pupil). Designing to respond to the needs, mores and preferences of these directors became a design principle that would help constrain and nudge UX design choices.

For teachers the ability to direct attention, to be flexible, to be able to assess progress were all principles that nudged the inclusion of certain features.

For the sports broadcasters an ability, at a time the director can select, to give suitable dominance to in programme promotions, alerting viewers to other content that may be appearing shortly was an important goal and accommodating this became a principle that guided the UX design.

7.1.4 Principle related to User Needs

Subject to the hierarchy of principles above, delivering to meet the needs of a user needs became a final key principle. Is the content choice relevant for the end user, might it be valued, is it easy to use? Whilst it is not possible to always be right when delivering innovation to users. We sought to deliver

value to the user, to create a better experience and this ambition guided our UX design choices and became the focus of our usability and experience tests.

It may seem surprising to see principles related to user needs are at the bottom of this hierarchy but it should be acknowledged that the principles higher up are also driven by users but with directors and content owners acting as proxies. Directors, producers, and the project are all seeking to deliver a good user experience according to their purpose and business objective.

7.2 Inherited design principles

Apart from the hierarchy detailed above other principles were adopted from standardized UX principles and from findings from earlier trials

7.2.1 Design principles for iOS

There are standardised sets of UX-principles which have emerged in recent years that are relevant to the 2-IMMERSE service trial designs. For example, the Design Principles for iOS 7⁴ (taken from the Human Interface Guidelines) reference the following a number of points which are relevant to 2-IMMERSE UX-design:

1. **Aesthetic integrity** – This relates to how well the appearance and behaviour integrates with its function. It's deemed sensible to keep decorative elements subtle and unobtrusive and to use standard controls where possible as these will have behaviours that users can anticipate and that are therefore predictable. Designs and experiences that have aesthetic integrity send a coherent message about its purpose and its identity and help people to trust it.
2. **Consistency** – This relates to using designs that allow people to transfer their knowledge and skills from one experience to another. It includes paying attention to the standards and paradigms people are comfortable with and also helps designers provide an internally consistent experience.
3. **Direct manipulation** – This relates to allowing users to manipulate onscreen objects. By allowing this users become more engaged with their task and it becomes easier for them to understand the results of their actions.
4. **Feedback** – This relates to providing perceptible feedback (audio/visual) in response to every user action. Acknowledging people's actions, showing them the results, and updating them on the progress of their task makes it easier for them to understand when they have effectively interacted with a user interface.
5. **Metaphors** – This relates to the wisdom of using onscreen objects and user actions that employ metaphors of familiar experiences. These experiences may be rooted in the real world or the digital world; in either case appropriate use of metaphors helps users quickly grasp how to use the experience.
6. **User control** – This relates to the wisdom of allowing users to initiate and control actions. Experiences can suggest a course of action or warn about dangerous consequences. It's important to find the correct balance between giving users the capabilities they need while helping them avoid unwanted outcomes. It suggests that familiar, predictable, simple and straightforward are all virtuous attributes.

7.2.2 Design principles from the UK government's Design Service

Similarly, the UK government's Design Service Design Principles from 2012 are also relevant to 2-IMMERSE UX-design⁴

⁴ <https://www.designprinciplesftw.com/collections/ios-7-design-principles>

Start with user needs - identifying user needs. Do research, analyse data, talk to users. Do not make assumptions. Have empathy for users, and remember that what they ask for is not always what they need.

1. **Design with data** - learn from real world behaviour. Let data drive decision-making, not hunches or guesswork. Test with users then iterating in response.
2. **Do the hard work to make it simple** - especially when the underlying systems are complex.
3. **Iterate. Then iterate again** - start small and iterate wildly. Iteration reduces risk. If it isn't working, don't be afraid to scrap it and start again.
4. **This is for everyone** - accessible design is good design. Make your design as inclusive, legible and readable as possible. Build for needs, not audiences from the start.
5. **Understand context** - think about the context in which users are using the services.
6. **Be consistent, not uniform** – use the same language and the same design patterns wherever possible. This helps people get familiar with the experience, but when this isn't possible make sure the approach is consistent.

7.2.3 Principles from previous service trials

As each 2-IMMERSE service trial was designed and evaluated, principles emerged and were then applied in subsequent service trials. For example here is an insight from the *Theatre in Schools* designer

“For the student input in the ‘Share’ part of the Theatre in Schools experience we used a similar approach to the presentation of the sports stats, again ‘not obscuring things on the screen’.”

Designer *Theatre in Schools*

7.3 A hierarchy of Design principles

There was a two-step process to identify and derive UX-principles during the development of the service trial demos. The first step identified relevant principles from previous service trials (that were core and transferrable), and principles from standardised sets.

The second step identified new principles. These principle could be derived from content owner requirements, and aims of the project that become ‘principles that would drive the platform development forward’. This bulleted list summarise the hierarchy of design principles that were applied throughout the project.

- Respond to the ambition, scope and resource of the project
- Respect what has gone before
- Respect existing good UX design principles

These principles have been used to guide the development of the service innovations, particularly when design choices are not obvious. The first ‘Respond to the ambition, scope and resource of the project’ ensures the outcomes reflect what the project set out to do. The second ‘Respect what has gone before’ encourages the development of incremental designs more likely to fit with current mores and tropes of the production industry and therefore more likely to gain acceptance and be acted upon by that industry. The third ‘Respect existing good UX design principles’ encourages adherence to accepted best practice.

In this hierarchy, the primary design principle was to respond to the ambition, scope and resource of the project and in cases of conflict, this would trump the need to respect what has gone before and even the need to respect all existing good design principles

The following list expands slightly on these principles:

1. Respond to the ambition, scope and resource of the project

- a. Designs should showcase the platform capabilities so should
 - i. Deliver the experience across multiple screens e.g. TV, Tablet and Phone
 - ii. Enable personalisation
 - iii. Use object-based graphics and audio
 1. Allow content owners to define layout options via templates/in-control of templates
 2. Offer audience driven personalisation and accessibility options
 3. Offer multiple audio channels (commentary on/off; ambient)
 4. Offer broadcasters controls to support regionalisation
 - iv. Use synchronised data-driven content
 1. Video, Graphics, Audio, Data, 360
 2. Synchronised script / subtitles
 3. Demonstrate incorporation of features of social networking such as text-chat and video-chat -across locations
- b. Designs should be reassuring to rights holders, but also aspirational:
 - i. Replicate the look and feel of current offering and
 - ii. Offer responsive variants of current presentations (onscreen graphics presented in 3x scales)
 - iii. Develop presentations for different levels of experience (*MotoGP at Home*: Novice, Fan, Expert; *Theatre in Schools*: Capability of student; *Football FanZone*: team supporter)
 - iv. Demonstrate how productions builds existing workflows demonstrating novel tools where necessary
 - v. Show how experiences can re-use and build upon current practice in terms of the use of use of 360 Video content.
- c. Designs should offer flexibility in presentation, this may include offering:
 - i. Responsive TV presentations – Graphics and PiPs
 - ii. User Experience Levels of audiences & team supporters
 - iii. Ability to choose to show content on a shared display
 - iv. User roles (offering various levels of curation/control)
 - v. Video ‘trick play’ controls
 - vi. (Video) Replays
- d. Design choices should be prudent; some good ideas aren’t tractable.
- e. Look for re-use: look to adopt design features already developed within the platform where practical.

2. Respect what has gone before. Broadcasters haven’t arrived at their current offerings by mistake.

- a. Respect current content guideline of owners/broadcasters
- b. Present ideas professionally, as though each is already a real product.
- c. Build your experience around the narrative generated by the existing production process, don’t obscure the image carrying the main narrative and don’t relegate it to a minor screen
- d. Develop the user experience building on the providers’ current offerings from the owners/broadcasters (from *MotoGP* and *BT Sport*; *Donmar*)
- e. Offer incremental evolution of the UX rather than step-change revolution.
- f. Our experiences must offer more than current offerings
- g. End users of course must be listened to and have some primacy, but designs also need to be attractive to those in the production chain and to rights holders.

3. Respect existing good UX design principles

7.4 Accessibility

One of the exciting opportunities related to object-based broadcasting and the inherent opportunity it brings for personalisation is that it would offer a ‘baked in’ way of supporting accessibility. The project is not an accessibility project per se but we accept the inherited design principle “this is for everyone’. Throughout the project adoption of this principle unearthed a number of features that could be seen explicitly as accessibility features, these are listed below in Table 5.

	2-IMMERSE service trial feature
<i>Visual signals</i>	High contrast graphics, red-green colour blindness adjustment. This was adopted in all service prototypes.
<i>Visual signals</i>	Pre-set, resizable overlay graphics & tables. This was used in <i>MotoGP at Home</i>
<i>Audio signals</i>	Alternative audio streams including clean audio commentary. These were used in <i>MotoGP at Home</i> and <i>Football at home</i>
<i>Audio signals</i>	Adjustable volume for audio commentary on individual devices. This was not implemented, but viable for all examples
<i>Audio signals</i>	Controlling the relative volume of the voice and ambient audio. This was used in <i>MotoGP at Home</i> . In the <i>Football at Home</i> users had the option to add/remove the commentary layer from the ambient audio track.
<i>Subtitling and synchronised scripts</i>	Synchronised script, available on the shared TV screen or on the individual device. This was used in theatre at home
<i>Subtitling and synchronised scripts</i>	Adaptation of the size and colour of text, or change the font, flexible font size and colour. These were not implemented in the prototypes but viable given object based media approach
<i>Subtitling and synchronised scripts</i>	Alternative methods of presenting the synchronised script/subtitles were explored in studies outside the service trials. This included an exploration of script/subtitles: <ul style="list-style-type: none"> • presented as a single line, as group of lines; • with scrolling and paging movements; • with and without character images and names for reference alongside the lines of text, to identify the speaker; • timing of the text presentation (how closely should it be synchronised with video). (Findings presented in D3.2)
<i>Audio description</i>	Not implemented for the performance extracts, but achievable using object-based media.
<i>Sign language interpretation</i>	Synchronised Augmented Reality Signing (available on Hololens headset). These were explored in a complementary study (see Chapter 4), not in a service trial.
<i>Synchronised tangible</i>	Tangible Companion Experiences. These were explored in a complementary study and reported in D3.4

Table 5 Describing accessibility features enabled by the object based broadcasting approach and how/whether they were used in 2-IMMERSE

7.5 UX insights and areas for future exploration

In this section we summarise examples of UX-insights that emerged from the service trials and that need further exploration.

7.5.1 Audio level management

Control of audio across multiple screens is an important consideration in multi-screen experiences. Audio from multiple connected companion-screens and a shared TV quickly creates a very muddled and distracting user experience. For single viewers, automatic volume control may be desirable. If multiple users are present solutions become more complex. The *MotoGP at Home* service innovation prototype highlighted issues with regard to the volume of the pre-race videos; the same issues were relevant for the extracts from *Julius Caesar* that were available on the tablets. The volume could conflict with the audio from the shared screen/TV presentation and/or other companion devices in close proximity.

7.5.2 Orchestration of user attention

Directing user attention is important. In *MotoGP at Home*, the proof of concept offered some rather extreme user experiences in some circumstances e.g. replays lasting 5 seconds shown across multiple screens with 5 camera angles. This was provided to showcase the capabilities of the platform rather than offering the best user experience.

7.5.3 Prompted configuration

In *MotoGP at Home*, Access to ‘in race’ configuration options need to be provided early in the user journey. The proof of concept only surfaced the ‘in race’ UI two minutes before the race. This caused people to be distracted at the start of the race as they were trying to get to grips with learning about all the features on offer and to configure the presentation to suit their needs. This issue was partly caused by us dropping the ‘Tutorial’ section in the experience which would have enabled the users to set preferences during the pre-race presentation.

7.5.4 Value of personalisation

Features such as Responsive TV Layout (optimised for 32”, 50” and 65” TVs), User Experience Levels (Novice, Fan, Expert), and Audio Controls (volume of Ambient and Commentary audio) were not marked particularly highly by users of *MotoGP at Home*. It is unclear if this is because they were not useful features, or they are configuration settings that were adjusted once at the start of the experience and then not recalled when completing the questionnaire. More study on usefulness of these features should be undertaken for sports genres. User experience levels may be of more value in the school/learning scenarios, which could personalise the content dependent on the student’s level of understanding. Although data analysis shows ‘Responsive TV Layout’ features were interacted by the majority of trialists, the size of trialists’ TV screens was not recorded, and so it was not possible to correlate scale selection to TV size.

7.5.5 Companion device functional parity

It was observed that some *MotoGP at Home* trialists wanted to use the phone in landscape mode, so as to more closely replicate the more fully featured tablet interface. During the trials not all the phones had their orientation locked to portrait only, which unfortunately led to a poor user experience (buttons too small, poor layout, etc.) as the App phone UI was not designed to be used in landscape orientation. There may be value in exploring the benefits of offering functional parity across all companion screen devices, even if the UI is more convoluted on smaller screen devices.

7.5.6 Replay provision

Replays were handled differently in both the *MotoGP at Home* Watch Live and Race Review chapters. In Watch Live replays were provided on both the TV and Companion Screen, where as in Race Replay event replays were only shown just on the Companion Screen. Further, we showed multiple camera viewpoints of the replay, where up to four replays could be presented at the same time. These facilities were developed to showcase the capabilities of the platform and to explore if viewers could follow multiple video streams across multiple devices. Observations suggest that provision of replays in this way was too much for viewers to digest, especially for very short replays that lasted for under 10 seconds.

7.5.7 Replay on TV with PiP and transitions

Dorna, the MotoGP rights holder, really liked the way replays were provided on the TV in Watch Live, which echoed how a replay would be normally presented within the traditional TV broadcast stream. We used animated transitions to cut between live coverage and replays shown on the TV and during a replay the live coverage was pushed into a PiP, so the viewer did not miss any coverage.

7.5.8 Graphics development workflow approaches

Within the project we explored two different workflows to develop OBB graphics. There are pros and cons to both approaches, but it is currently unclear which approach is more likely to be adopted within industry. For *MotoGP at Home*, graphics were developed in Adobe Animate and exported into HTML5, CSS and JavaScript. Pros/Cons of this approach include: graphic objects are optimised for web presentation, shortens and reduces cost in current graphics development workflow (where graphics are typically designed in Adobe After Effects then recreated in a graphics engine such as Prime), can be easily made interactive for touch devices, can be more complex to create and code. In Football graphics were developed in *Prime* (an industry standard OB graphics production/control tool) and a plug-in enabled the graphics to be rendered in client browsers. Pros/Cons include: simple generation and export process, OBB can utilise current assets developed within Prime, assets currently require more client-side processing, graphics cannot currently be made interactive.

7.5.9 Editing and customising content and offering interactivity

This includes: adding one's own content, supporting differentiation, editing tasks/activities, personalising lesson plans. The service trial for *Theatre in Schools* was designed with the view that all content, in the longer term, could be edited, customised or replaced with new content and a customisation interface could be built on top of the content mark-up document we developed for the prototype.

7.5.10 Use generated content

This includes recording users' audio, filming users, sharing videos, and longer form writing, in the *Theatre in Schools* prototype. Some user-generated content was vetoed on technical and GDPR reasons during the 2-IMMERSE project, except for text-based content (lines for *Theatre in Schools*, and text-chat and video-chat in Theatre at Home), and recording audio. But there was not scope within the project's time-limits to develop the use of UGC further.

7.5.11 Persistence

The ability to save user-generated (student) material, individual contributions and progress, in order to resume (pick-up) at a later date (for another lesson), and to save materials and progress as revision aids, was perceived as valuable by teachers but was outside the project goals.

7.5.12 Checking for understanding

It became clear that teachers would value resources and capabilities that would allow them to check whether learning goals had been achieved. This might include exam type questions, fellow student feedback, the recording of achievements, and teacher notes, was also out of scope of the project goals.

8 Conclusions

This final chapter outlines the key conclusions from the process of developing the user interaction design and the experimentation work that informed the design of the *Theatre in Schools* service proposal.

As noted previously, this deliverable covers the work and the thinking that led to the development of the service trial. It does not cover the test methodology or the results of the trial which are covered in WP4 documentation, or the technical development of the Production Tools detailed in WP5.

Key conclusions include:

- background research, and especially the observation of students watching schools broadcasts of Shakespeare plays, was fundamental to the process;
- key experiences identified during this process, which also informed the UX-design were consideration of a variety of interpretations of the play being studied; use of captions and scripts to dissect and perform scenes; teacher curation; and the control of the second screen remote control;
- similarly essential was participation in and collaboration with the workshops led by the Donmar education team; these workshops enabled the 2-IMMERSE team to align its UX-design with the aims of the Donmar;
- the UX-design team adapted three of the exercises developed by the Donmar education team based on plot, rhetoric and characters, and developed and built prototype modules for the first two of these;
- design criteria worked with principles derived from the scope and resource of the project, the goals of the Donmar, the requirements of teachers, the requirements of pupils; and the wider canon of good UX-principles;
- 2-IMMERSE and the Donmar collaborated productively to inform the design of the prototype, to adapt learning materials and content, and to plan evaluation in schools;
- the adoption of a timeline and the lesson structure of Watch / Make / Share proved to be productive frameworks for the creation of the learning modules;
- key capabilities drawn on from previous 2-IMMERSE service trials were object-based graphics and audio, synchronised content and multi-screen experience;
- new capabilities introduced were a content browser, bookmark timeline, user annotation, aggregated live interactions and inputs, audio management, orchestration of user attention, and a branching timeline;
- learning objectives for both the Story Builder and Script Detective modules were identified as helping students learn and better understand, respectively, the plot of *Julius Caesar* and the way rhetorical devices can be used to achieve particular effects;
- by creating the two learning modules 2-IMMERSE was able to demonstrate a framework that could both be tested in field trials and could be seen to support different types of learning content
- a group of key areas for future exploration, including audio level management, orchestration of user attention, prompted configuration, value of personalisation, editing and customising content and offering interactivity, user generated content, persistence, and checking for understanding.;
- the project adopted the following hierarchy of design principles:
 - Respond to the ambition, scope and resource of the project
 - Respect what has gone before
 - Respect existing good UX design principles

Annex A Supplementary Work

Complementary studies were carried out in parallel to the main workstream. The aim was to explore usability and design issues from perspectives that were not incorporated or viable within the main workstream use cases and service-trials, due to technology, time or resource constraints. These studies add to the knowledge base generated by the 2-IMMERSE project.

This section covers an exploration of a synchronized companion experience to aid access for deaf audiences. The content of the section is an extract from a successful paper submission to TVX'18⁵. It outlines the design and development of an Augmented Reality Sign Language Interpreter. The Synchronised Interpreter was evaluated with deaf users, and the results have been submitted in a technical paper to CHI'19⁶.

Personalising the TV Experience with Augmented Reality Technology: Synchronised Sign Language Interpretation. (IRT & BBC)

BBC R&D and IRT have been exploring how to customise and personalise the experience of viewing programme content on connected TVs by, in tandem, delivering additional (companion) content, to personal devices via IP [1, 2]. So far, our investigations have focused on personal devices like a mobile phone or tablet. However, with the rise in popularity of optical head mounted displays, augmented reality (AR) applications enable a way to make experiences that might spill out beyond the frame of a TV thereby extending the real estate of the TV screen. As a probative part of our study, we chose to look at placing a video stream of a sign language interpreter just outside the TV frame synchronised to the programme content within the TV frame.

Traditional access services undoubtedly enhance the experience for many users but they remain an intrusive option which can't be customised and controlled beyond turning them on/off in the case of subtitles and audio description. Considering that the TV might be a shared device watched by others, potentially with different personal preferences, how can access services be delivered without imposing one users' preference on the whole group [4]? Even if the social issues are mitigated through compromise, there are users who experience different types of impairments at different times during their lives or under different conditions. Some users experience multiple impairments often with increasing age. Add in personal preferences, such as not being able to proficiently read subtitles because English is not the users' first language or wanting to watch a particular programme on the all of the screen real estate available to the user [4], it becomes obvious that there may be merit in being able to present personalised augments, including potentially some access services, to the TV experience outside the TV frame.

This is a description of the process we undertook while designing a companion application on the HoloLens [7] which displayed a sign language interpreter to accompany a programme. We discuss justifications behind our selections and the challenges we faced in creating a suitable representation of the sign language interpreter in AR.

Accessibility and the TV

There is a significant percentage of the population for whom access services remain invaluable as a means to better consume our audio-visual content. Broadcasting in European countries like, the UK and Germany, is subject to regulation on various fronts including a remit to meet these access requirements [8]. These regulations provide us with a guideline to start thinking of novel ways of making our programme content accessible to users with impairments.

⁵ *Personalising the TV Experience with Augmented Reality Technology: Synchronised Sign Language Interpretation*. By Vinoba Vinayagamoorthy, Maxine Glancy, Paul Debenham, Alastair Bruce BBC Research & Development, Christoph Ziegler and Richard Schäffer IRT. TVX '18 Proceedings of the 2018 ACM International Conference on Interactive Experiences for TV and Online Video. Pages 179-184 SEOUL, Republic of Korea — June 26 - 28, 2018.

⁶ ACM CHI2019, paper submission, *Personalising the TV Experience using Augmented Reality: An Exploratory Study on Delivering Synchronised Sign Language Interpretation*. By Vinoba Vinayagamoorthy, Maxine Glancy, BBC Research & Development, Christoph Ziegler and Richard Schäffer, IRT.

The Use Case: Sign Language delivered in AR

We carried out a review of literature relevant to the use of current signing for TV practice. This included industry guidelines, recommendations and reports from organizations and academic studies. As far as we can tell, there are no official guidelines for the presentation of sign language interpreters on TV from the German regulation authorities, so we looked to UK-based legislation [8] and a review of prior work [5, 10, 11].

Some recurring themes emerged to include the quality of the signing, the prominence and presentation of the interpreter, the scale and position of interpreter within the TV frame, the interpreters' relationship with the TV content, problems associated with 'cutting off the signing' and 'overlap with the TV content', and the continuity and synchronisation of the signing with the TV content. These were all challenges that were continuously considered through while designing the HoloLens companion application to the TV.

The programmes used on the TV by BBC R&D⁷ and IRT⁸ were both set in the Sahara and chosen because we were able to extract a segment with a self-contained sub-story which worked well for a relatively short experience piece. We worked with BSL & DGS⁹ sign language interpreters to capture their interpretations of the aforementioned programmes in the form of videos. The captured videos were processed to extract 2D video cut-outs of the interpreter (referred to as AR Interpreter in this paper) using Chroma-Keying. We consider different design formats in order to design optimal ways to present the AR interpreter to a user wearing a HoloLens while also watching a programme on a TV.



Figure 87 Capturing the interpreter using blue LED lights and Chromatte (reflective cloth) at BBC R&D.

⁷ *Morocco To Timbuktu: An Arabian Adventure*, BBC Two

⁸ *Herausforderung Wüste: Sinnsuche in der Sahara*, Bayerischer Rundfunk (BR)

⁹ British Sign Language (BSL) and Deutsche Gebärdensprache (DGS) are the sign languages of the deaf community in the U.K. and Germany respectively. They are distinct languages and recognised as such by the government.



Figure 88 Capturing the interpreter using a green studio set-up at IRT.



Figure 89 In-Vision interpreter as seen on a typical interpreted content piece.

Capturing Content

Our review revealed the importance of the interpreters' relationship with the content. In addition to 'ease of shifting attention', a relationship can be demonstrated via the direction of the interpreters' gaze and their synchronized interaction with the TV content. This was tackled during the capture process.

Direction of Gaze –Designing with the Interpreter

While resting (not actively signing), in-vision interpreters usually direct their gaze towards the TV content, as if watching it with the viewer. In the studio, during the capture process, we discussed the possibility of recording a variety of 'directions of gaze' with the interpreter. The interpreter was filmed gazing in 3 directions:

- Facing into the camera –as if looking at the viewer;
- Looking horizontally to her right - so the interpreters' eyes were level with the presenter's eyes on the TV;
- Looking down diagonally to the bottom right –as if standing by the side of a TV placed on a stand.

Ensuring Synchronisation Interaction

If the user feels a delay between the TV content and the signing, this can break the continuity of the experience. [8, 10]. In the UK, steps were taken during the capture shoot to ensure synchronization. We playing the documentary content in front of the BSL interpreter for use as cues. We recorded the programme sound via a live microphone, allowing us a way to initialise alignment during processing.

Language: *“So far as possible, interpretation and voice-overs of signed programmed should be synchronised with the original speech / sign language” [8]*

In Germany, the capture process was slightly different. A deaf DSG interpreter read multi-line subtitles from a TV-screen with the original video in the background. An additional hearing signer checked if the deaf signer was in sync with the TV's audio. This was to comply with an agreement between hearing and deaf interpreters in Germany, that recorded content shall only be interpreted by deaf interpreters.

Signing Space

In-vision interpreters restrict their signing space to a ‘safe-zone’ to guarantee that the signing is not ‘cut-out’ of the content within the TV frame [10]. The HoloLens has quite a small field-of-view, similar in shape to a letter box, so it was difficult for the user to see the TV and the signer within it. So, the interpreter was asked to maintain the use of a ‘safe-zone’ while signing during the capture process.

Placement of Content in AR

After Chroma-keying the captured interpretations of the content, we considered the best way to present the AR interpreter in a synchronised sign language interpreted TV+HoloLens experience.

Prominence and Presentation of the Interpreter

To ensure the prominence of the interpreter, and get a crisp Chroma-keying outline of the interpreter in the HoloLens, we took some precautionary measures. The interpreter could not wear the same colour as the backdrop against which they would be Chroma-keyed - blue in the U.K & green in Germany (see Figure 87 and Figure 88). The interpreters were asked to avoid black since it appears transparent in the HoloLens. We wanted the AR interpreters to have enough contrast against real world spaces so we chose to avoid dressing the signer in white and light neutral colours. No jewellery was allowed, to avoid the impact of reflective surfaces on the capture quality. The interpreters' hair was neatly combed or tied back, to avoid a ‘fuzzy’ outline in the Chroma-keying process.

Appearance: *“The signer should use a style of interpretation and wear clothing that is appropriate to the style of the programme ... It is important that signers' clothing allows them to be seen distinctly against the picture” [8]*

Signing Quality & Techniques

The quality of the signing is more important than the presentation of the interpreter [5, 8, 10]. This concerns the interpreters' ability to give full translations of the content, without the user feeling as if there are details missing. We sent the qualified interpreters a copy of the script and links to the documentary footage several days before the capture shoot. This was crucial to let them get familiar with the content.

Quality: “Sign language presenters, reporters and interpreters should be appropriately qualified, both to use sign language of native competency, and to communicate effectively through television” [8]

Technique: “The signer should use appropriate techniques to indicate whose speech he or she is interpreting, and to draw attention to significant sound effects” [8]

Size, Position and Scale

The interpreter should not dominate the screen, and should not obscure the TV content [8, 10, 11]. Traditionally on TV, in-vision interpreters appear in half body (head to hip - Figure 89) or 2/3 body (head to mid-thigh) formats on the right hand side of the TV screen. Full-body (head to toe) formats are not used because the clarity of the interpretations is reduced.

Size: “The image of the signer superimposed upon the original programme should generally appear on the right hand of the screen and occupy a space no smaller than one sixth of the picture.” [8]

In an Augmented TV space, we didn’t have to compromise between the size of the interpreter and the space available for the content. We explored the half body and 2/3 body formats, in the HoloLens, by scaling the Chroma-keyed video cut out of the interpreter to match the height of the TV-screen. This meant that the top of the AR interpreters’ head was level with the top of the TV frame, while the bottom half of the AR interpreter was placed on the surface on which the TV stood. Eventually, we considered the 2/3 body format too similar to the half body format.

We explored three scales of the full-body AR interpreters. A life size version of the AR interpreter in which the AR interpreters’ head was well above the TV frame while the AR interpreters’ feet was on the floor. However, the narrow field of view of the HoloLens made it difficult to easily shift attention between the AR interpreter and the content on the TV. We considered a full-body interpreter scaled to the height of the TV, however, the clarity of the signing diminished with the reduced scale. The third version of the full-body AR interpreter was slightly less than life size version. In this case, the top of the AR interpreters’ head was level with the TV frame while the AR interpreters’ feet stood on the floor of the room. This compromise allowed the top half of the full body AR interpreter to be placed in parallel with the height of the TV frame and allow the AR interpreters’ legs to be included in the HoloLens environment (Figure 91).

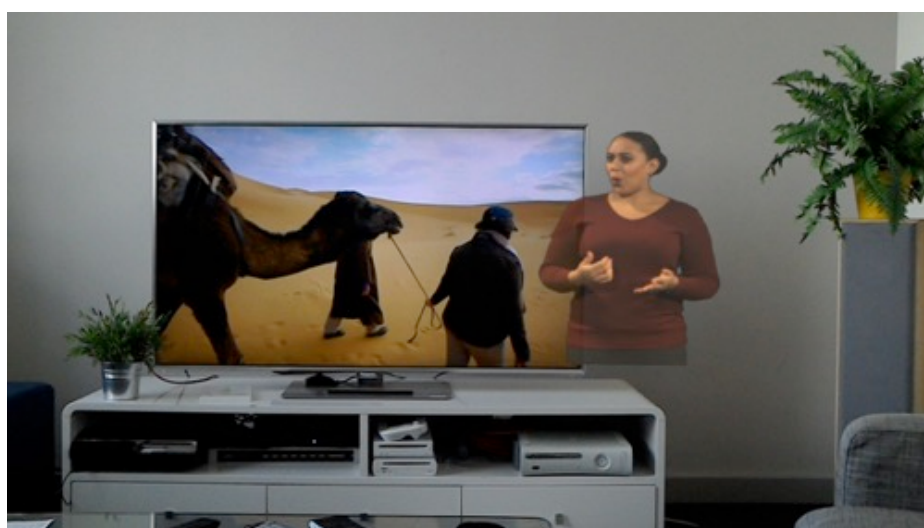


Figure 90: Half Body Signer – View through the HoloLens. The user sees the half body signer ‘sitting’ on the TV stand on the right hand side of the TV.



Figure 91: Full Body Signer – View through the HoloLens. The user sees the signer ‘standing’ on the floor on the right hand side of the TV.

Distance & Overlap

Similar to in-vision concerns [8], we did not want too much overlap between the signer and important parts of the TV content. However, we were also aware that the distance between the interpreter and the TV content needs to allow users to shift attention between the two entities. If the distance is increased, shifting attention becomes tiresome and the connection is broken. The ‘ease of shifting attention vs overlapping’ was of key importance [10].

In both our designs, the interpreter was positioned to the right of the TV frame, slightly overlapping the frame (to no more than 1/6th) reducing the distance between the signer and the TV content.

Choosing the Interpreters’ Direction of Gaze

We invited a colleague with BSL skills to review the AR signers’ position and scale, to review the clarity of the signing, and which of the 3 ‘directions of gaze’ were most suitable. The condition in which the AR signer was gazing along a horizontal line to the TV screen, in the half-body and full-body designs, was favoured.

Discussion

The slightly less than life size full-body format and the half-body format seemed the best two designs to study in further user experiments. These two designs also seemed diverse enough to not be seen as slight variations of the same thing. All designs were placed on the right hand side of the TV frame in keeping with Ofcom recommendations [8] and prior studies [5, 6]. The aim is to maintain a ‘connection’ between the signer and the content, and in-turn the ‘continuity’ between the user, the signer and the content.

Limitations

The HoloLens will be a new technology for participants in the study – introducing the novel factor. It is anticipated that participants will respond to the physical effects of wearing the HoloLens, which can be heavy and uncomfortable, especially if wearing spectacles. The HoloLens has a limited field of view, and this could compromise the presentation of the AR Interpreter. Users will have to be briefed beforehand in order to properly tease out what factors are used to evaluate our designs.

Conclusion and Future Work

We have presented two potential designs for AR interpreters for use in viewing sign language interpreted content on TV+HoloLens experiences. In addition to the design work, BBC R&D and IRT are working together on explorative ongoing user studies with three goals.

- Gain an early understanding of how members in the BSL and DSG communities respond to accessing sign language interpretations through the HoloLens in AR,
- If there are any differences due to the way sign language interpretations are consumed across two cultures and
- Confirm the reproducibility of our design approach and methodology of our ongoing studies.

References

1. 2-IMMERSE Home Page. 2-IMMERSE. Retrieved March 27, 2018 from <https://2-IMMERSE.eu/>.
2. BBC R&D - Companion Screens: Creating a viewing experience across more than one screen. BBC R&D Blog Post. Retrieved March 27, 2018 from <http://www.bbc.co.uk/rd/projects/companion-screens>.
3. BBC R&D – Unconventional Screens: Exploring the potential of future display technologies. BBC R&D Blog Post. Retrieved March 27, 2018 from <https://www.bbc.co.uk/rd/projects/unconventional-screens>.
4. Mike Armstrong. Object-Based Media and Accessibility. 2018. BBC R&D Blog Post. Retrieved March 27, 2018 from <https://www.bbc.co.uk/rd/blog/2018-01-accessibility-object-based-media>
5. Matthew Dye. The Digital Age: Digital and Signed TV. Deaf Studies Trust. 2000
6. Hbb4All. D6.4 – Pilot-D Evaluation and Recommendations. 2017. Retrieved March 29, 2018 from <http://pagines.uab.cat/hbb4all/content/deliverables>
7. Microsoft. Microsoft HoloLens. Retrieved March 28, 2018 from <https://www.microsoft.com/en-gb/hololens>
8. Ofcom. The Ofcom Code on Television Access Services. 2017. Retrieved March 27, 2018 from <https://www.ofcom.org.uk/tv-radio-and-on-demand/broadcast-codes/tv-access-services>
9. Radu-Daniel Vatavu. 2013. There's a world outside your TV: exploring interactions beyond the physical TV screen. In Proceedings of the 11th European Conference on Interactive TV and Video (EuroITV '13). <https://doi.org/10.1145/2465958.2465972>
10. Benice Woll. Sign Language on Television. Centre for Deaf Studies, University of Bristol. 1991.
11. Yan Wu, Elaine Price and Leighton Evans. Digital Television and Deaf/Hard of Hearing Audiences in Wales. Research Institute for Arts and Humanities, Swansea University. 2014. Retrieved from March 29, 2018 from <http://www.swansea.ac.uk/riah/research-projects/dtv-wales-survey/>