# The Role of Computer Games in the Education of History

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## ABSTRACT

The goal of this paper is to assess if computer games based on historical facts have an effect in the education of history. We have conducted a series of experiments on the Computer Science (Games Technology) students at Charles Sturt University. We have written two documents of equivalent content on two separate historical events and chosen a computer game based on one of these events. We have also prepared a questionnaire that includes 10 generic questions to assess the students' learning of this material. In the experimental studies, we presented one of these events as a text document only, and the other as a text document followed by a game-play session where the game contained historical facts included in the text. The experiment was conducted with 12 randomly chosen Australian students between the ages of 18 to 25. After the reading of the document only on the first event the students were tested, and after the game play session following the reading of the text on the second event the students were tested. We found the test results higher for the text document followed by the game-play session. In this paper, we draw conclusions from these findings and suggest that computer games support education of history with the presentation of a proactive and interactive learning environment.

## Categories and Subject Descriptors

K.3 COMPUTERS AND EDUCATION: K3.1 Computer Uses in education

## General Terms

Measurement, Experimentation, Human Factors.

## Keywords

Computer Games, Education, History, Experimentation.

## 1. INTRODUCTION

How can we build on the learning experiences associated with computer games, drawing on the inspiration, insight and evidence provided by leading experts in both learning and games technology? In November 2002, Game On- conference [1] Edinburgh addressed this question.

Recently, Becta (British Educational Communications and Technology Agency) developed a project called Computer Games in Education [2]. The aim of this project is to see how games can enhance learning activities and what unforeseen uses of technology they may demonstrate.

In this study, our purpose is to assess if computer games based on historical facts have an effect in the education of history. Several research studies have been done on effects and impacts of computer games on players. Palmberg [3] reported on the design and results of an experiment to test the effects of playing computer games on the learning of English vocabulary by young elementary-level Swedish-speaking children. Raszkiewicz [4] explored the impact of aggressive visual messages upon adolescents and found that occasional playing of games made the subjects more sensitive to differences between good and evil, where as frequent playing of games reversed this effect in the sense that it made the subjects less able to differentiate between aggressive and non-aggressive behavior.

Squire [5] stated that research of the last 20-30 years has shown that certain aspects of computer games could have potential in a learning environment. These include increased motivation, effectiveness in an inquiry based framework, collaboration and competition. He proposed to combine state-of-the-art gaming with contemporary pedagogical models (problem solving, case-based reasoning, models and simulation) to create a new generation of educational media.

The journal "Wired News" [6] stated the following; The Digital Media Collaboratory --one of several technology laboratories at the University of Texas at Austin's IC2 Institute-- works with partners from the public and private sectors to develop computer games that can be used by schools, businesses and governments. It created a pilot program in 1998 called EnterTech, a 45-hour training simulation that teaches 44 entry-level job skills through digital role playing. Of the 238 participants, two-thirds of the group either found work or enrolled in continuing-education programs.

The BBC report "Video games 'stimulate learning'" [7] stated that Professor Angela McFarlane of Teem found that Computer games had significant educational value, and suggested they could become part of the school curriculum. The UK study concluded that simulation and adventure games - such as Sim City and RollerCoaster Tycoon, where players create

societies or build theme parks, developed children's strategic thinking and planning skills. Parents and teachers also thought their children's mathematics, reading and spelling improved.

The BBC report [8] "Video games 'valid learning tools'" stated that "Research found youngsters learned more effectively from information presented in audiovisual form such as a video game, than from facts on a printed page.". The report commented on the findings of Psychologist Dr David Lewis, who carried out an experiment (commissioned by Sony PlayStation) on 13 and 14 year olds playing the computer game MediEvil 2. Dr Lewis discovered more than three-quarters of the subjects absorbed facts contained in the historical video game as opposed to little more than half who were presented with the same information in written form.

In this study, we tested the effects of playing Battlefield 1942 to reinforce facts given in a text document. Battlefield is a popular multi-player first-person shooter war game based on an actual historical event. We conducted a series of experiments on 12 Computer Science (Games Technology) students at Charles Sturt University. All of the students were males between the ages of 18 to 25, and all except one were Australians with a native language of English. They had all played the Battlefield 1942 computer game more than 20 times before and they considered themselves as average to advanced game players. None had experienced technical problems in interacting with the game environment during the game-play session.

We prepared two documents of equivalent historical value and chose a computer game based on one of these historical events. We also prepared a questionnaire that included 10 questions to assess how much information the students absorbed.

In the first stage of the experimental studies, we presented an historical document related to the Hellendorn Battle in World War II. We gave 10 minutes to the students to read the document. Then, we asked them to play the Helllendorn level of Battlefield 1942 multiplayer computer game in pairs for 10 minutes. At the end of the game play session, we gave the questionnaire to the students and had them answer the questions in 10 minutes.

In the second stage of the experimental studies, we presented an historical document related to the Anzac Battle of World War I. We gave 10 minutes to the students to read the document. Then, we gave the same questionnaire to the students and again had them answer the questions in 10 minutes.

One could expect that Australian students normally would be able to give more correct answers to the questionnaire about the Anzac Battle in Gallipoli as this is a far more important and relevant event in Australian history than the Hellendorn Battle in Holland.

According to our findings, the number of correct answers was higher for the Hellendorn document followed by a game-play session. In this paper, we draw conclusions from these findings and suggest that computer games support learning of history with the presentation of a proactive and interactive learning environment.

## 2. EXPERIMENTAL PROCEDURE

This study was conducted at the School of Information Technology, Charles Sturt University by using the equipment listed below:

1- A document about the Hellendorn Battle of World War II

2- Battlefield 1942 Computer Game Multiplayer version

3-A document about the Anzac Battle of World War I

4-A questionnaire including the same 10 questions for both documents

5-12 male participants (between the ages of 18 to 25 and experienced in game-play)

6-Two different computers for the participants

7-1 digital video camera

8-1 TV to play back the game play session

9-1 VCR

10-The maps of Gallipoli and Hellendorn to support the documents visually

Two computers were connected to each other via an Ethernet crossover cable to set up a LAN party to play Battlefield 1942. Students were placed in such a way that they were not able to see but speak to each other. Each student's perception of the game environment was different, as each player had his own avatar to interact with the game environment and used the first person view. Some had chosen to be a sniper, some a tank commander. All -except for 1 team who fought against each other- chose to be allies.

Experimental procedure was as follows:

1-Reading the Hellendorn Battle document (5 minutes).

2-Playing Battlefield 1942 multiplayer game in pairs (10 minutes) and Recording game play session by a digital camera

3-Answering the questionnaire (10 minutes).

4-Reading the Anzac Battle document (5 minutes).

5-Answering the questionnaire (10 minutes).

6-Watching game-play session and interviewing with the students about their experience (20 minutes).

In this paper we only report on the first 5 stages mentioned above.

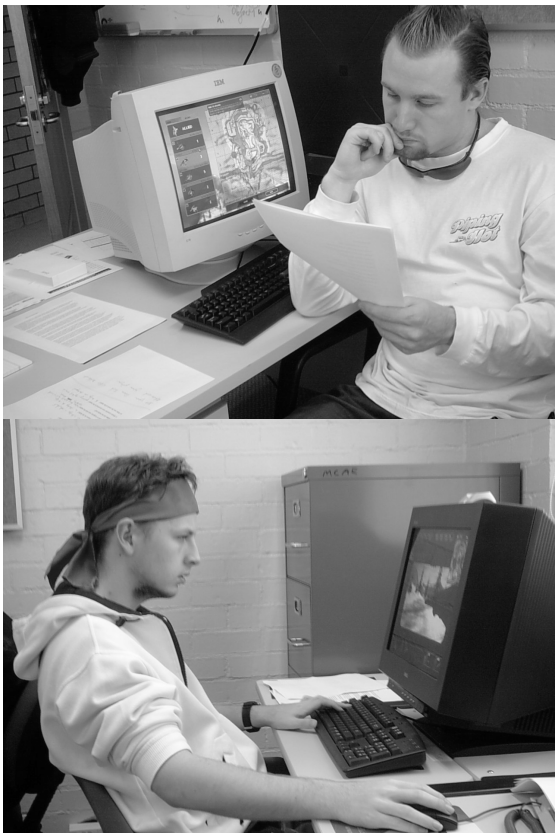

**Figure 1. Experimental set up**

## 3. EXPERIMENTAL RESULTS

In the following tables students are coded as S1,S2,...,S12. Values that indicate min 10% differences between Table-1 and Table-2 are shown in shade. We collated this data to show individual student success by overall test result, and overall student success by particular question.

**Table 1. Assessment of the Hellendorn questionnaire**

| Ques | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 | S12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 10 | 10 | 10 | 10 | 0 | 10 | 10 | 10 | 0 | 10 | 0 | 6.7 |
| 2 | 0 | 10 | 10 | 0 | 0 | 0 | 10 | 10 | 10 | 10 | 0 | 0 | 5.0 |
| 3 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 10 | 10 | 0 | 0 | 0 | 2.1 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0.8 |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 10 | 10 | 0 | 8.8 |
| 6 | 10 | 10 | 10 | 10 | 10 | 0 | 10 | 5 | 5 | 0 | 0 | 10 | 6.7 |
| 7 | 10 | 10 | 10 | 10 | 10 | 6 | 6 | 10 | 10 | 10 | 5 | 10 | 8.9 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 10 | 0 | 0 | 0 | 2.5 |
| 9 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 10 | 10 | 10 | 10 | 10 | 9.6 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 0 | 10 | 10 | 0 | 0 | 10 | 7.5 |
| sum | 5 | 7 | 7 | 6 | 6.5 | 3.6 | 6.1 | 9.5 | 8 | 4 | 3.5 | 4 | 5.9 |

**Table 2. Assessment of the Anzac questionnaire**

| Ques | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 | S12 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 0 | 10 | 0 | 10 | 10 | 10 | 0 | 10 | 10 | 10 | 10 | 7.5 |
| 2 | 0 | 0 | 10 | 0 | 10 | 0 | 0 | 0 | 10 | 0 | 0 | 10 | 3.3 |
| 3 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 1.7 |
| 4 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 2.5 |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 0 | 10 | 10 | 10 | 10 | 10 | 9.2 |
| 6 | 5 | 5 | 5 | 0 | 5 | 0 | 5 | 5 | 5 | 5 | 0 | 5 | 3.8 |
| 7 | 3 | 0 | 7 | 3 | 0 | 3 | 3 | 0 | 10 | 3 | 3 | 5 | 3.3 |
| 8 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 10 | 10 | 0 | 0 | 0 | 2.5 |
| 9 | 10 | 7 | 10 | 10 | 10 | 7 | 10 | 10 | 10 | 10 | 10 | 10 | 9.5 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 0 | 10 | 10 | 10 | 10 | 0 | 8.3 |
| sum | 4.8 | 4.2 | 6.7 | 4.3 | 7 | 4 | 2.8 | 5.5 | 7.5 | 5.8 | 4.3 | 5 | 5.2 |

### 3.1 Individual Student Success

7 out of the 12 students were more successful in the questionnaire about the Hellendorn Battle.

**Table 3. Students' success in the Hellendorn document versus the Anzac document**

| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 | S12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEL | 5 | 7 | 7 | 6 | 6.5 | 3.6 | 6.1 | 9.5 | 8 | 4 | 3.5 | 4 |
| ANZ | 4.8 | 4.2 | 6.7 | 4.3 | 7 | 4 | 2.8 | 5.5 | 7.5 | 5.8 | 4.3 | 5 |

As seen in Figure 2, the level of success between the two questionnaires is around 40% for some students. One third of the tested students were at least 17% more successful in the Hellendorn Battle document. Only one sixth of the tested students were 10 to 18% more successful in Anzac Battle document.

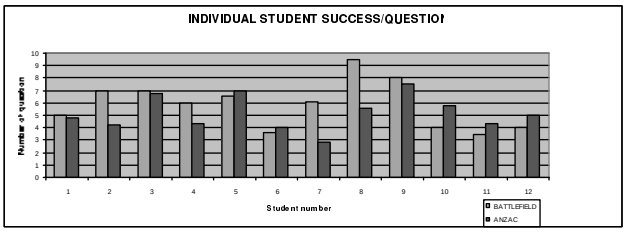


**Figure 2. Student success**

### 3.2 Overall Student Success

Table-4 shows the overall student success rate between the two documents. The rate is 51.5% in the Anzac Battle Questionnaire, whilst it is 58.5% in the Hellendorn Battle Questionnaire.


**Figure 3. Photos from the experiments**

**Table 4. Overall student success per question**

| No | Question | ANZAC | HELLENDORN |
|---|---|---|---|
| 1 | When did this battle start? | 7.5 | 6.7 |
| 2 | Who gave the order to start the battle? | 3.3 | 5 |
| 3 | Who were the commanders of both sides? | 1.7 | 2.1 |
| 4 | When was the first attack? | 2.5 | 0.8 |
| 5 | Where did they fight? | 9.2 | 8.8 |
| 6 | What was the reason for the battle? | 3.8 | 6.7 |
| 7 | What kind of weapons was used the battle? | 3.3 | 8.9 |
| 8 | When did the battle end? | 2.5 | 2.5 |
| 9 | Which countries were involved in the battle? | 9.5 | 9.6 |
| 10 | What was the result of the battle? | 8.3 | 7.5 |
| Sum | | 51.6 | 58.5 |

Figure 4 and Table 4 indicates that Battlefield 1942 computer game reinforced the learning from the Hellendorn Battle document in certain aspects. Students were more successful in answering the questions 2, 3, 6, and 7 after playing Battlefiled 1942. These questions were "who gave the order to start the battle?" (17%), "who were the commanders of both sides?" (4%), "what was the reason for the battle?" (29%) and "what kind of weapons was used the battle?" (56%). The game was particularly specific about these points, though not about the facts involved with the questions not so successfully answered.

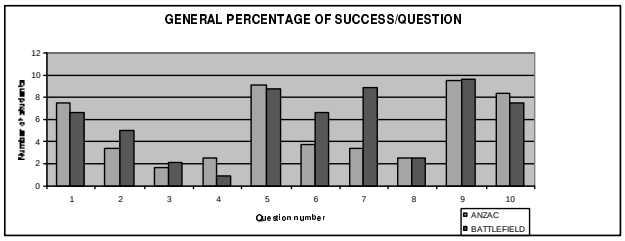


**Figure 4. Overall Success Rate**

On the contrary, students were more successful in the Anzac Battle Questionnaire in question 1, 4, 5, and 10: "when did this battle start?" (8%), "when was the first attack? (13%), "where did they fight?" (4%) and "what was the result of the battle?" (8%). The reason for the lower success in the Battlefield 1942 computer game in this area is because it presents incorrect information such as the date of the Hellendorn Battle, which in fact happened in 1945. 67% of the students gave incorrect answers to question 1 "when did this battle start?" The Battlefield 1942 computer game successfully taught a wrong fact by exploiting the strong impacts of visualisation, interactivity, simulation and realisation. An incorrect fact is presented in the game, and students remember the game's information over that given in the document. This also points out the danger of incorrect facts presented in popular media.

# 4. TEACHING HISTORY IN COMPUTER SIMULATIONS

Following are a number of pedagogical methods [9] that can be implemented in computer games:

**a- Plain Reading:** This method includes the delivery of the historical information either by books or by a teacher.

**b- Imagination:** Imagination stimulates attention to the event and facilitates memory. We may categorize a number of methods under this heading as they all support imagination.

**b1-Simulation:** This method simulates a historical event by using media and/or imagination. For example, ANZAC soldiers may be referenced in a specific film or may be associated with soldiers in a war movie which is shown prior to the delivery of the associated historical information. Sims that refer to simulation form a computer game genre. This type of computer game is generally used for training pilots, police officers, etc., with the realistic environment they provide.

**b2-Role playing:** Heroes and characters of an historical event may be associated with actors in a movie. Thus the audience can visualize the event in their minds, and link the characters to historical ones. A parallel exists in computer games by representing characters using avatars.

**b3-Visualisation:** Visualization includes using video, pictures, photographs, maps, etc to deliver the facts and fiction. Computer games present a good ground for all kinds of computer graphics, digital images and video.

**c- Association:**

**c1- Association with first hand memory:** In the delivery of an historical event, it is possible to associate the event with the memories of a witness or someone close to the witness. For instance a person or their parent may remember a recent event such as the Falklands War, or Queen Elizabeth's Silver Jubilee, and when this event is recounted by the witness, the audience can virtually travel from today to the past using the story-teller's own memories as a vehicle. In computer games, a similar vehicle can be provided by using video clips of actual accounts of an event.

**c2-Association with heroes:** If the historical event is closer to the date, it is possible to invite the living heroes of the event to the class and interview them. In computer games, this may be possible by programming interactive 3-dimensional avatars to be interviewed and respond to questions. An advantage in the computer game is that the avatar can represent anyone in history, dead or alive.

**d- Communication:**

**d1-Communication with objects:**

Visually and physically interacting with objects used in historical events (at a museum for example) stimulates imagery. The information about the event may be delivered to the audience in

the museum during interaction. In computer games, it is possible to interact with the objects by using avatars.

**d2-Travelling to historical sites:**

The historical event may be delivered by visiting the historical site. For example, Australians visit the ANZAC Memorial in Gallipoli for sentimental reasons. Computer simulations may bring the advantage of free virtual travel to the site.

## 5. CONCLUSION

Lave and Wenger [10] argue that learning is a function of the activity, context and culture in which it occurs (i.e., it is situated). Social interaction is a critical component of situated learning. Learners become involved in a community of practice which embodies certain beliefs and behaviors to be acquired. Situated learning is usually unintentional. This is called the process of "legitimate peripheral participation". In this study we found that a computer game may reinforce learning of an historical event with the presentation of a proactive and interactive learning environment that is suitable for legitimate peripheral participation.

Situations might be said to co-produce knowledge through activity. Learning and cognition are fundamentally situated... Learning and acting are indistinct. Learning being a continuous, life-long process resulting from acting in situations... Activity, concept and culture are interdependent. No one can be totally understood without the other two.

Brown et al. [11] emphasized the idea of cognitive apprenticeship: "cognitive apprenticeship supports learning in a domain by enabling students to acquire, develop and use cognitive tools in authentic domain activity. They also emphasize the need for a new epistemology for learning – one that emphasizes active perception over concepts and representation. In our study we also found that computer games emphasize active perception over concepts and representation, and this may cause selective reading and recognition of the presented facts by evoking players attention.

The theory of information pickup [12] suggests that perception depends entirely upon information in the "stimulus array" rather than sensations that are influenced by cognition. Gibson proposes that the environment consists of affordances (such terrain, water, vegetation, etc) which provide the clues necessary for perception. In our study, we relate the stimulus array to the immersive environment of the game, such as the graphics. The affordances can be related to the virtual environment of the game, as in the design and representation of the terrain.

Constructivism [13] refers to the idea that learners construct knowledge for themselves – each learner individually (and socially) constructs meaning – as he or she learns. Constructing meaning is learning. Affordances in a game may help players construct knowledge for themselves.

Learning is not the passive acceptance of knowledge that exists "out there" but learning involves the learners engaging with the world. Because of the interactivity and the immersive environment provided by computer games, computer games may act as active tools for knowledge acquisition.

It would be beneficial to develop computer simulations and games and test their ability to support the learning of history. It is vital in projects of this kind that we use historians to make absolutely sure that the correct information is represented in the game, as the game is a powerful learning media. Conflicting information presented in a game may be absorbed, replacing that presented in books and documents.

The ANZAC battle [14,15] is an important event in Australian history, however our findings indicate that the Australian students we tested were worse at answering the questionnaire on the ANZAC Battle than answering the same questionnaire on an event which has much less to do with their own history. This indicates that game play has an effect in teaching. A computer simulation or a game may help students learn Australian history.

Squire [5] outlines his design commitments:

- Appeal to a broad audience
- Address gender imbalances
- Leverage existing genres – work within the tradition and push genres
- Grounded in existing learning sciences research
- Provide "transgressive play" to test limits of social acceptability
- Address misconceptions
- Provide a sense of presence
- Sociability

In addition to these, the following should be considered in developing a computer game on the Anzac Battle:

1- Affordances (commander, other characters, heroes, materials, objects, and weapons used in the war) should be realistically simulated.

2- The reasons for the war should be carefully delivered.

3- War strategies and their results should be realistically detailed.

4- A team of historians and educational scientists should be heavily involved.

Our test results indicate that computer games stimulates learning and therefore, they may be considered active learning tools.

## 6. ACKNOWLEDGMENTS

This study was conducted while Dr Bayram Akca was a Visiting Fellow at Charles Sturt University (CSU). Our special thanks to the Computer Science (Games Technology) students who participated the experimental studies, and CSU Research Office

which supported this study. Experimental studies were sponsored through the Australian Research Council Linkage Grant numbered LP0216837 to Dr.Manolya Kavakli.

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## 8. APPENDICES

### 8.1 The Questionnaire

**QUESTIONS**

1-When did this battle start?

2-Who gave the order to star the battle?

3-Who were the commanders of both sides?

4-When was the first attack?

5-Where did they fight?

6-What was the reason for the battle?

7-What kind of weapons was used the battle?

8-When did the battle end?

9-Which countries were involved in the battle?

10-What was the result of the battle?

### 8.2 The Document on the HELLENDORN Battle

### HELLENDORN

The Ludendorff Bridge was one of the great railway bridges of Germany built during the First World War.Here is the story of the destruction of the bridge during the Second World war.

On the morning of March 7 1945, American troops of the U.S. First Army surprised the German garrison at the old Ludendorff railway bridge across the Rhine River and captured the bridge. The German defenders of the bridge did manage to detonate a huge charge that raised the bridge in the air but, it settled back to its foundation, seemingly intact.

Hitler ordered the immediate destruction of the bridge using any and all means possible. The 9th and 11$^{th}$ panzer Divisions hurried to battle the American 9$^{th}$ Division in the bridgehead. On March 08, ten Luftwaffe aircraft attacked the bridge, scoring two hits.

On March 14, there had also been a series of attempts to destroy the bridge, including the firing of eleven V2 rockets from their base at Hellendorn, in Holland. V2 rocket had accuracy problem in hitting the target.One rocket landed only three hundred yards from the bridge; another fell twenty-five miles away, near Cologne.

Also on March15,Twenty-one German jet aircraft attacked the bridge with poor results-fifteen of the aircraft were shot down by U.S anti-aircraft batterys.

Hitler then tried other weapons on the bridge. These include; a tremendous 17-centimeter railroad artillery gun, intreped underwater scuba men and also the use of the V2 rocket to strike the bridgehead area. On March 16,American units further

extended the Remagen bridgehead, cutting the Cologne-Frankfurt autobahn.

Hitler notified German General Bayerlein that he was ordering the attack of Remagen using V2 rockets-regardless of casualties to civilians. Late on the evening of March 16-because of the accuracy problems with the new terror weapon-the Germans fighting in the bridgehead were moved back from the area about 9 miles.

Then, on March 17,worn out by the pounding of American artillery units nearby, the bridge collapsed; twenty-five American engineer were killed. By then, however, two temporary bridges had been thrown across the river, and several thousand troops were on the far side. Not knowing that the bridge had collapsed, on the night of March 17,six German frogmen entered the Rhine upstream and, using oil drums, floated explosive charges towards the bridge. All six were seen, and captured.

## 8.3 The document about the ANZAC Battle

## GALLIPOLI

On 4 August 1914,war was declared between German and England. Andrew Fisher accepted to send 30.000 Anzacs to help British government.

Northern plan to commit Allied forces to the desolate Gallipoli Peninsula of southern Turkey in April 1915 was a result of a plan by Winston Churchill to attack Germany through its Turkish ally. The proposal initially was for a naval operation to breach the heavily defended Dardenelles Strait, to allow warships to threaten the Turkish capital, Constantinople (now called Istanbul),thus forcing the clear surrender of the Turks. Optimistically, only a small land force was envisaged to clear away coastal gun batteries which might interfere with the naval operation.

The naval attack began on 19 February but minefields and shore-based artillery inflicted heavy casualties. A concerted attack in mid-March by 18 battleships resulted in a third of them being sunk. Churchill began pushing for a much more substantial land attack. Gradually the British War Council became convinced that that troops would have to be landed on the Gallipoli peninsula to eliminate the forts and mobile howitzers.

British General Hamilton was ordering the attack in Gallipoli Peninsula. He finally decided to land the 29th Division on five beaches at the toe of the peninsula around Cape Helles. To the north, the Anzac forces would make a second landing.

Meanwhile Birdwood was given the task of developing the Australian plan. He had entirely Australian division and a composite New Zealand and Australian Division, about 25.000 men in all.

The first major attack was on the morning of 25 April 1915 the battleships anchored about 3.500 yards off the coast of the Gallipoli Peninsula. The result was that the whole force was landed on a narrow front with units bunched and intermixed from start.

In the event the 3rd Brigade failed to achieve their original objective-the capture of Gun Ridge. The 2nd and 1st Brigades and later the formations of the New Zealand and Australian divisions had all landed around Ari Burnu (later known as Anzac Cove).

Turkish commander Mustafa Kemal (later, as Kemal Ataturk, to become President of Turkey) was in charge of the Turkish forces.

The second major attack was on 6 August to capture the Sari Bair ridge . There was a great deal of confused fighting at the end of August. Back in London the possibility of evacuation was debated. The troops were removed over a period of several weeks. Eventually, on 19and 20 December, the evacuation of Anzac and Suvla was complete. There was hardly a casualty. The Gallipoli “experiment” was at an end.

The Gallipoli operation cost 26.111 Australian casualties of whom 8.141 were killed.

In addition New Zealand suffered 7.571 casualties of whom 2.431 were killed.

Britain endured a total of 120.000 casualties at Gallipoli and the French 27.000.The Turkish total was probably about220.000.