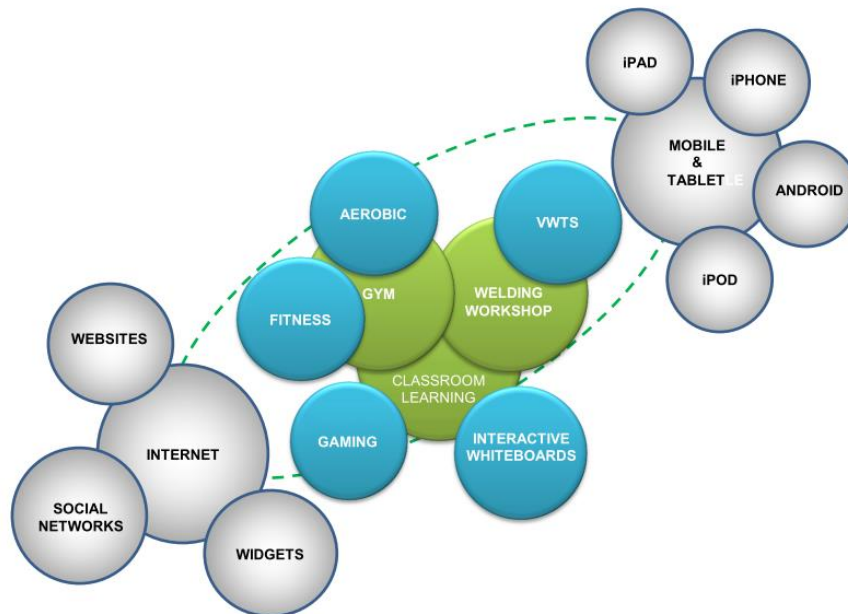


Report



Analysis of applicability of new methodology and teaching materials in education and introduction of VWTS into training of welding trainees and professionals

Slavonski Brod – Porto Salvo – Oberhausen – Basel – Wels – Zagreb



Introduction

The grounds for the research to be continued within the project were laid in 2010/11 by conducting the first research on a sample of 60 students attending the Industrial and Trade School Slavonski Brod.

The first group involved students who went through the interactive training, and second group were students who only went through the training on real welding machines.

Interactive training encompassed 30% on VWTS with the passing level of 50% + 70% training on real welding machines.

Welding process: MAG – 135

Trainings:

1. training: Joint type : fillet weld $a=4$, one layer, welding position: PB
2. training: Joint type: single V butt weld, one layer, welding position: PA
3. training: Joint type: single V butt weld, 2 layers, welding position: PA

A new research was conducted in 2011/12 on a sample of 58 students attending the Industrial and Trade School Slavonski Brod. Interactive training encompassed 30% on VWTS with the level of 55% + 70% training on real welding machines.

Welding process: MAG – 135

Trainings:

- | | |
|-------------------------------------|-------------------------------------|
| 1. Fillet weld – 1 layer PB | 1. Fillet weld – 1 layer PF |
| 2. Single V butt weld – 1 layer PA | 2. Single V butt weld – 1 layer PF |
| 3. Single V butt weld – 2 layers PA | 3. Single V butt weld – 2 layers PF |

Another research was carried out at the Industrial and Trade School Slavonski Brod on a sample of 64 students in 2012/13.

The interactive training encompassed 40% on VWTS with the level of 55% + 60% training on real welding machines.



Welding process: MAG – 135

Trainings:

- | | |
|-------------------------------------|-------------------------------------|
| 1. Fillet weld – 1 layer PB | 1. Fillet weld – 1 layer PF |
| 2. Single V butt weld – 1 layer PA | 2. Single V butt weld – 1 layer PF |
| 3. Single V butt weld – 2 layers PA | 3. Single V butt weld – 2 layers PF |

All the results of the above-mentioned research undoubtedly demonstrated progress in welding skill of those students who went through the interactive training as opposed to the students who were only involved in training on real welding machines.

During 2012/13, research was carried out with professional welders with the purpose of correcting their welding technique - 36 professional welders with work experience from 3 to 35 years, employees of Končar Steel Structures, Zagreb

Three-day training was carried out using VWTS (100%).

Welding process: MAG – 135:

- initial testing of candidates on the VWTS – simulation concept (3D weld) for the welding of fillet weld in horizontal position at the level of 65%
- training of candidates on the VWTS - training concept for fillet welds in horizontal position and single V butt welds in horizontal position for one and two layer welding at the level of 60%
- final testing of candidates on the VWTS – simulation concept (3D weld) for fillet welds in horizontal position at the level of 60%

Research results demonstrated a 20% improvement of welding technique after the use of VWTS.

1. Research within the project InteractivWeld

2013/14 research was carried out at the Industrial and Trade School Slavonski Brod on a sample of 120 students.

The first group involved students who went through the interactive training, and second group were students who only went through the training on real welding machines.

Interactive training encompassed 40% on VWTS with the level of 60% + 60% training on real welding machines.

Welding procedure: MAG – 135

Trainings:

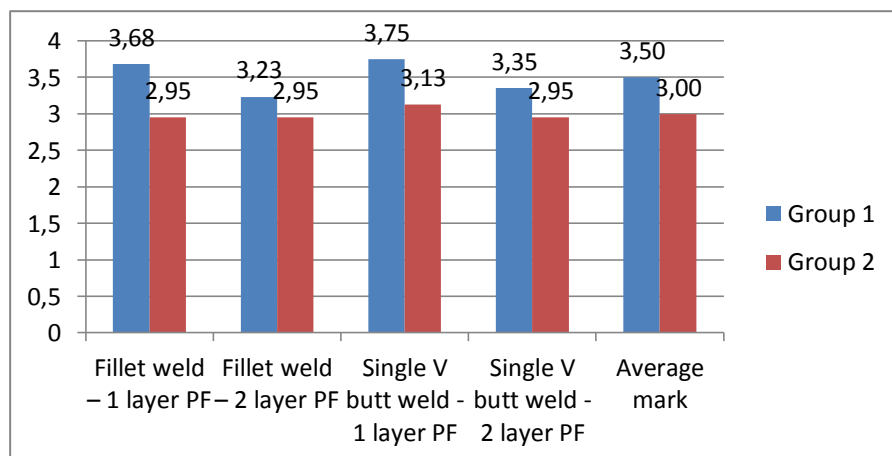
1. Fillet weld – 1 layer PB
2. Single V butt weld – 1 layer PA
3. Fillet weld – 1 layer PF
4. Fillet weld – 2 layer PF
5. Single V butt weld - 1 layer PF
6. Single V butt weld - 2 layer PF
7. Fillet weld – 1 layer PD
8. Single V butt weld – 1 layer PE

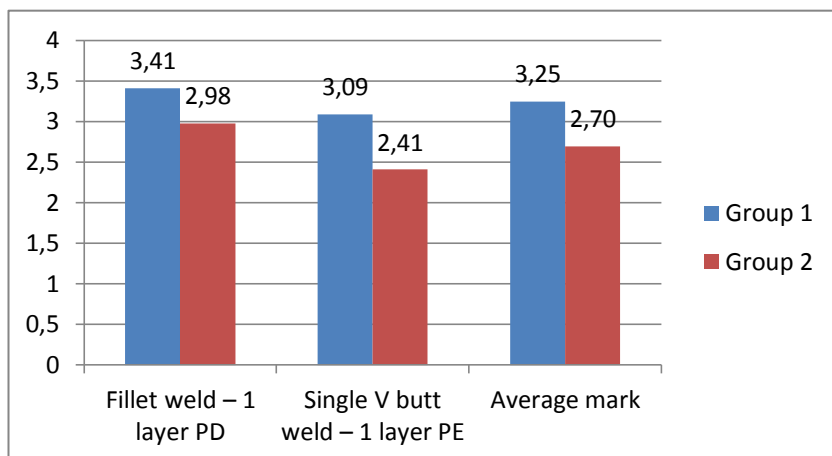
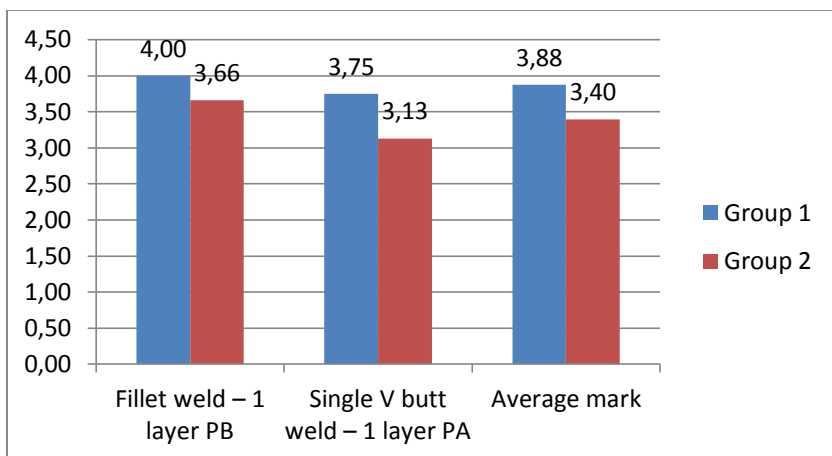
Welding procedure: MMA – 111

Trainings:

1. Fillet weld – 1 layer PB
2. Single V butt weld – 1 layer PA
3. Fillet weld – 1 layer PF
4. Fillet weld – 2 layer PF
5. Single V butt weld - 1 layer PF
6. Single V butt weld - 2 layer PF
7. Fillet weld– 1 layer PD
8. Single V butt weld - 1 layer PE
9. Fillet weld, tube to plate – 1 layer PB

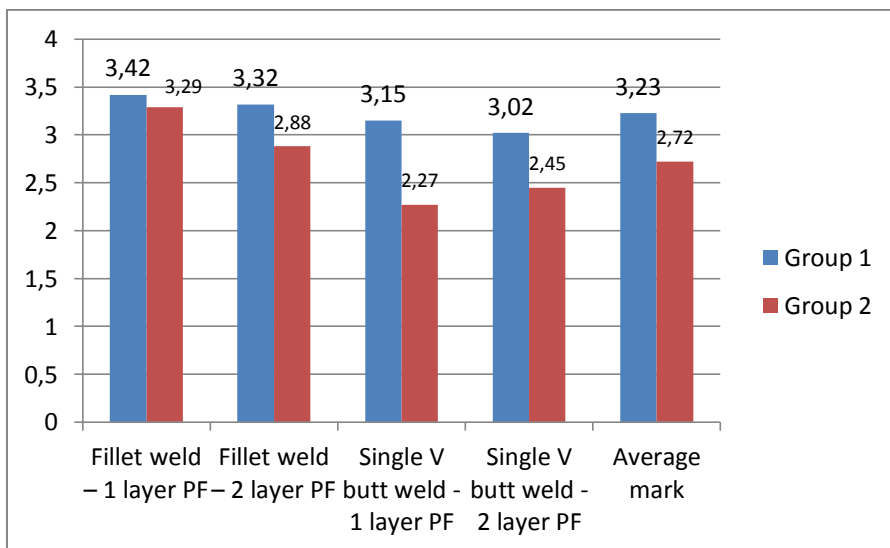
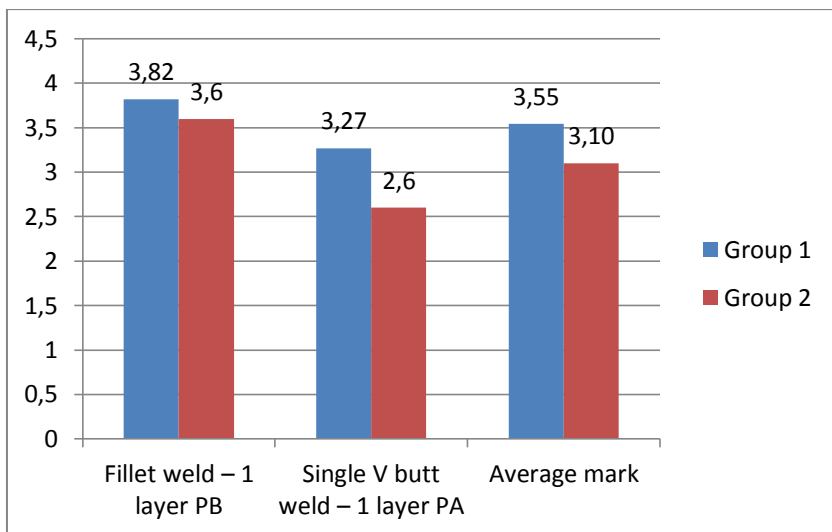
Results of research MIG/MAG welding - IOS

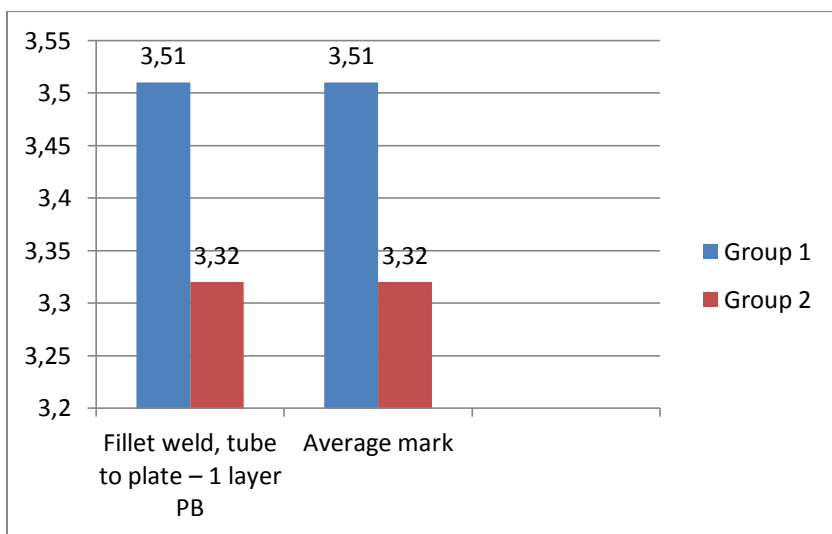
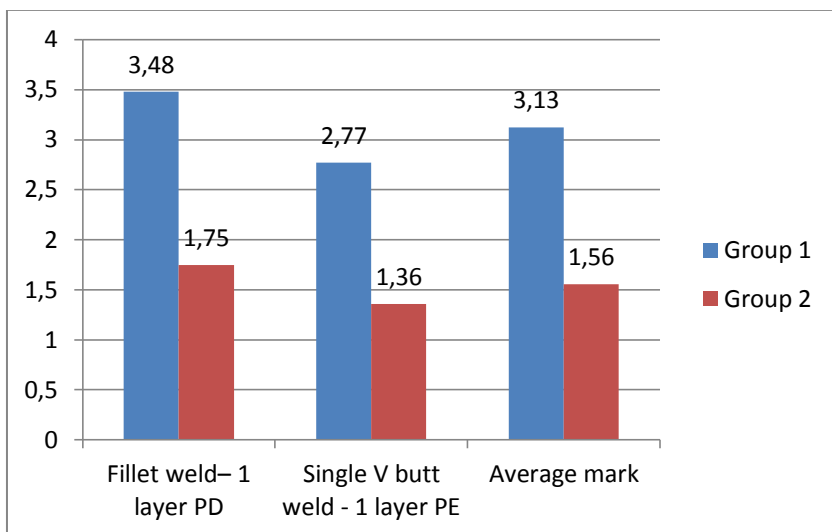




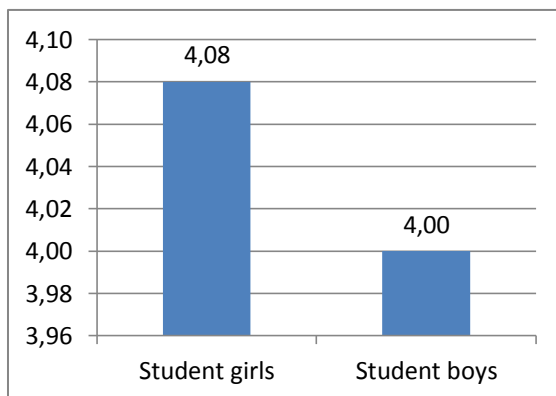
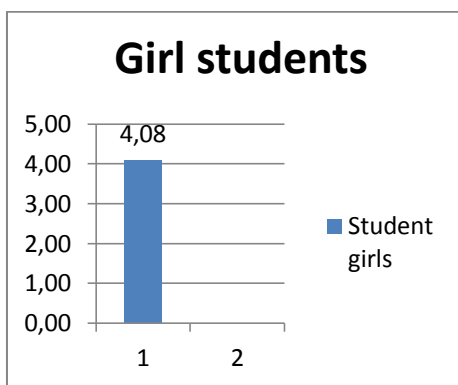
Students' accomplishment chart after the training on real welding machines following the introduction of the VWTS into the interactive training system (2nd year of education)

Results of research MMA welding - IOS





Students' accomplishment chart after the training on real welding machines following the introduction of the VWTS into the interactive training system (1st year of education)





Girl students' accomplishment chart after the training on real welding machines following the introduction of the VWTS into the interactive training system - MAG Fillet weld – 1 layer PB

Research within the project was also carried out with 20 professional welders, employees of Končar Steel Structures, Zagreb.

Welding process: MAG – 135:

- Initial testing of candidates on the VWTS (simulation with fixed parameters at 65 %)
- Training of candidates on the VWTS (training Speed/Stick-out/Position 65% + simulation with fixed parameters at 65 %)
- Final testing of candidates on the VWTS (simulation with fixed parameters at 65 %)

- | | |
|----------------------------|-----------------------------|
| 1. PA Butt Joint Suceoni 1 | 7. PB Fillet Joint Kutni 1 |
| 2. PA Butt Joint Suceoni 2 | 8. PB Fillet Joint Kutni 1 |
| 3. PA Butt Joint Suceoni 3 | 9. PB Fillet Joint Kutni 2 |
| 4. PF Butt Joint Suceoni 1 | 10. PB Fillet Joint Kutni 3 |
| 5. PF Butt Joint Suceoni 2 | 11. PF Fillet Joint Kutni 1 |
| 6. PF Butt Joint Suceoni 3 | 12. PF Fillet Joint Kutni 2 |



Year	No. professional welders	Welding process	No. of trainings	Type of welded joints Position	Improvement (%)
2013/2014	20	MAG – 135	12	Butt weld, three passes - PA	10,9%
				Butt weld, two passes - PF	37,1%
				Fillet weld, one pass - PB	3,5%
				Fillet weld, three passes - PB	11,6%
				Fillet weld, two passes - PF	28,7%

Table 1 Results of research for professional welders



2. Conclusion

A four-year research into the influence of a virtual device on the quality of student welders/trainees and professional welders encompassed a sample of 302 students and 76 professional welders.

Evaluation of real samples was carried out in teams by independent inspectors. The inspection was executed according to the ISO 5817 standard. Adjustment of demands to high-school grading system and the evaluation form itself were done by Swiss Welding Association (SVS). SVS trained IOS inspectors and participated in one part of the evaluation.

During this 4-year research the percentage of trainings and the threshold on virtual device were gradually increased up to the share of 40% and threshold of 60% for students, whereas the correction of welding technique with professional welders was carried out 100% on the virtual device with the threshold of 60% to 65%.

After the research, the control groups were sent for a testing of their welding technique on the virtual device. The testing showed a need for welding technique correction.

Improvements in the trainings of professional welders demonstrated a need for correction at least once a year.

The research undoubtedly demonstrated the need for compulsory use of the virtual device in welder training – with trainees a share of 40% of their entire training, and share of 100% when correcting the welding technique with professional welders.