 applied to training on key competences WP6. AR.KEY pilot

# Augmented Reality applied to training on key competences 

## WP6. AR.KEY pilot

D7. Pilot experience report

## EU Lifelong Learning Programme 2007-13

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- Centro de FormaÇao Professional de Industria da ConstruÇao Civil e Obras Públicas do Sul (Portugal).
- Fundación Laboral de la Construcción (Spain).
- Universitat de València. Instituto Universitario de Investigación Robótica y Tecnologías de la Información y Comunicación (Spain).
- Fundatia Romano-Germana Timisoara (Romania).
- Centro Edile Andrea Palladio (Italy).
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7. Introduction

### 1.1 Description

The WP6 aimed to put into practice the system, by carrying out some pilots, in which AR.KEY was validated from a technical and pedagogical point of view. Hence, a pilot experience has been carried out in each participating country, being participants thereof unskilled workers from the building industry. The objectives of this phase were:

- Design of the pilot experience: objectives, assessment indicators, students' profile, etc.
- Training of trainers in the use of the application.
- Assessment of students' starting level in order to provide them the most suitable training possible.
- Training of students by using the AR.KEY system.


### 1.2 Phases



Pilot experience
report

## Design of the pilot:

This task aimed to set up the context, goals, design of assessment indicators, technical design and pedagogical assessment and definition of the teaching-learning process (objectives, content, profile of participants, activities, timing, monitoring and tutoring).

## Training of trainers

Since the system is also intended to support the work of trainers as didactical resource, prior to the pilot with students, partners had a training session with trainers in order to brief them concerning the main characteristics of AR.KEY system.

Thus, the idea was that trainers master this teaching resource, in order to make the most of its pedagogical possibilities.

## Assessment of students' level

The application have a self-assessment module (evaluation ex-ante) in which the student had the opportunity to assess his/her performance regarding to key competences. The system scores the performance in order to place each student in the correct training path within the application as follows:

## ER <br> key

Scale value
I do not know nothing about the issue
I know the topic but not for application in construction
I know the topic in theory but cannot remember its practical application, I've forgotten
I know this topic in practice but I do not know the theoretical concept

I know perfectly the topic both the theoretical and the practical utility and its application in the work

## Start

This scale was designed to allow users to self-assess their competencies. Therefore, the user answers a questionnaire following the criteria explained in the table above. The system contains 36 questions with the next format:

1/36

Using of Smartphone and tablets or other devices alike

| $1-2$ | $3-4$ | $5-6$ | $7-8$ | $9-10$ |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |

Afterward, once the survey is completed, the APP gives a feedback to the trainee depending on his/her performance by issuing the following results:

Results

You should check the next lessons:
$1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17$

## Ok

This kind of self-assessment was explained during the pilot training in order to make attendees to understand the way it works this evaluation module. In the annex I, the reader can find the whole questionnaire.

## Training of students

The activities to implement each pilot were:

- Selection of participants.
- Administrative management of the training.
- Technological assistance for the pilot.
- Monitoring of participants in each of the learning objects.
- Performance assessment (evaluation ex-post).
- Development of learning assessment report.


### 1.3 Data

| Place | Trainees | Trainers | Date |
| :--- | :--- | :--- | :--- |
| FLC, Madrid. Spain | 10 | 5 | $24^{\text {th }}$ of September |
| FRG, Timisoara. Romania | 29 | 11 | $29^{\text {th }}$ of September |
| CENFIC, Lisbon. Portugal | 25 | 6 | $24^{\text {th }}$ of September |
| CEAP, Vicenza. Italy | 29 | 7 | $21^{\text {st }}$ of September |
| BZB, Krefeld. Germany | 10 | 1 | $23^{\text {rd }}$ of October |
| Total | 103 | 30 |  |

2. spain

### 2.1 Introduction

The pilot training was held the $24^{\text {th }}$ of September 2015 at FLC facilities in Madrid (Fundación Laboral de la Construcción) with the participation of 5 trainers and 10 trainees. The trainers came from different training courses on construction crafts, while the trainees were participating in several courses, namely: "Installation of laminated plaster plate", "painting" and "Health \& Safety".

\section*{Place Trainees Trainers Date <br> | FLC, Madrid. Spain | 10 | 5 | $24^{\text {th }}$ of September |
| :--- | :--- | :--- | :--- |}

### 2.2 Procedure

During the first part of this Pilot Training, Mr. Francisco Herreruela (trainer and didactic resource technician) and Mr. Luis Manuel Barrios (international projects technician), presented the ARKEY application to the trainers and trainees. Francisco Herreruela is expert in the most technical concepts related to the construction industry and in Augmented Reality (AR) tools. Francisco's expertise make him the most suitable trainer for this pilot, while Luis Manuel Barrios supported him should any specific questions concerning the project arise or issues related to mathematics, science and technology, key competencies being reviewed during this training.

The second part of the training was dedicated to the most practical activities regarding the application of AR. To do so, Francisco plugged the mobile device to the beamer and explained the trainees the different exercises directly shown on the screen.

The third part consisted in a summary of the project (aims, others results, EU funding, etc.) as well as an approach to possibilities of transfer of innovation to others related sectors.

Finally, the attendees filled in the ex-post questionnaire in order to know their opinion concerning the app developed. The results are explained in the next section.

### 2.3 Results

The results of the survey are shown in the following tables:

| Question | N | Average |
| :--- | :--- | :--- |
| Do you think the use of augmented reality in construction is something <br> new and innovative? | 15 | 4,60 |
| Do you think that safety in building works in particular on renovation and <br> energy rehabilitation is a major issue? | 15 | 4,67 |
| Do you think that similar procedures should be developed for other types <br> of works, i.e. civil work activities? | 15 | 4,87 |
| 01. Tutorial for the use of tablets - smartphones. | 15 | 4,13 |
| 02. Triangles and angles operations. | 15 | 4,07 |
| 03. Rule of three. | 15 | 4,00 |
| 04. Geometric shapes. | 15 | 3,93 |
| 05. Measures equivalences. | 15 | 4,40 |
| 06. Materials behaviour. | 15 | 4,40 |
| 07. Knowledge of geography. | 15 | 4,27 |
| 08. Geology knowledge. | 15 | 4,40 |
| 09. Behaviour of the climatology and effects on the edification. | 15 | 4,40 |
| 10. Acoustic properties of the materials. | 15 | 4,33 |
| 11. Thermal properties of the materials. | 15 | 4,27 |
| 12. Ventilation concept and characteristics. | 15 | 4,00 |
| 13. Thermal bridges, how and why avoid them. | 15 | 4,20 |
| 14. New construction machinery. | 14 | 4,00 |
| 15. Small machinery. | 15 | 3,87 |
| 16. Application of the technology to the construction (insulation). | 15 | 4,40 |
| 17. Application of the technological progress to new needs to the | 15 | 4,33 |
| renovation and energy rehabilitation of buildings. | 15 | 4,20 |
| Information regarding technology of insulation and/or installation. | 15 | 4,00 |
| Theoretical maths concepts (geometric shapes). | 14 | 4,14 |
| Theoretical science concepts (geographic orientation). | 15 | 3,93 |
| Theoretical technological concepts (thermographic camera). | 15 | 3,80 |
| Practical maths exercises (rule of three). | 14 | 3,93 |
| Practical exercises of science (noise and environmental conditions). | 14 | 4,00 |
| Practical exercises of technology (new machinery). | 14 | 4,36 |
| Key competencies procedures consider health and safety good practices. |  |  |

2. Spain

Generally, the possible applications of AR to training has been highly valued as well as its potential application to others related sectors.

The "lowest" scorings can be found in aspects such as the use of new construction small machinery, practical exercises (the "rule of three") or theoretical technological concepts (thermographic camera), but it is not worth to mention since the punctuations are near 4.

As for the open comments verbalized by the attendees, it is noteworthy to highlight the following ones:

- It is necessary to place on the APP some suggestion to find out the right way to solve the exercises.
- It would be convenient to deploy much more difficult exercises.
- Some comments concerning the usability of the APP in different construction activities and activity sectors.
- It would be useful to have one image per each Learning Outcome in order to facilitate the relationship between theoretical contents and practical exercises.


### 2.4 Pictures


3. Romania

### 3.1 Introduction

The pilot training was held the 29th of September 2015 at FRG facilities and CTV (West Technical College with the participation of 11 trainers and 29 trainees. The training was conducted by Dan Ionel Lazar; Gheza Kelemen; D. Marius Neagoe.

```
Place Trainees Trainers Date
FRG, Timisoara. Romania 
```


### 3.2 Procedure

During the first part of this Pilot Training, people in charge, presented the ARKEY application to the teachers and trainers. A deep knowledge of the technical concepts related to construction was very useful to a better reformation and rehabilitation tasks approach and to the learning outcomes derived therefrom.

The second part of the training was dedicated to the most practical activities related to the application of augmented reality, that is, to show how this tool works, to show how it has been applied to the acquisition of basic skills and the proposed exercises.

The third part consisted in a summary of the project (aims, others results, EU funding, etc.) as well as an approach to possibilities of transfer of innovation to others related sectors.

Finally, the attendees filled in the ex-post questionnaire in order to know their opinion concerning the app developed. The results are explained in the next section.

### 3.3 Results

The results of the survey are shown in the following tables:
The survey was divided in three different areas. The first one related usability and innovation of the contents, technics and the tool to develop it.

| Question | N | Average |
| :--- | :--- | :--- |
| Do you think the use of augmented reality in construction is something <br> new and innovative? | 40 | 4,15 |
| Do you think that safety in building works in particular on renovation and <br> energy rehabilitation is a major issue? | 40 | 4,75 |
| Do you think that similar procedures should be developed for other types <br> of works, i.e. civil work activities? | 40 | 4,46 |

The average is over 4 and it seems a good average in this range of items. The possible applications of augmented reality to training has been highly valued.

The possibility of application to other areas of construction or other productive sectors has also been highly valued.

Only some competences are valued negatively as a result of the difficulty in solving the exercises in the app. (i.e. small machinery).

| Question | N | Average |
| :--- | :--- | :--- |
| 01. Tutorial for the use of tablets - smartphones. | 40 | 3,71 |
| 02. Triangles and angles operations. | 40 | 4,21 |
| 03. Rule of three. | 40 | 3,36 |
| 04. Geometric shapes. | 40 | 4,38 |
| 05. Measures equivalences. | 40 | 4,32 |
| 06. Materials behaviour. | 40 | 4,60 |
| 07. Knowledge of geography. | 40 | 3,99 |
| 08. Geology knowledge. | 40 | 4,14 |
| 09. Behaviour of the climatology and effects on the edification. | 40 | 4,26 |
| 10. Acoustic properties of the materials. | 40 | 4,24 |
| 11. Thermal properties of the materials. | 40 | 4,57 |
| 12. Ventilation concept and characteristics. | 40 | 4,43 |
| 13. Thermal bridges, how and why avoid them. | 40 | 4,11 |
| 14. New construction machinery. | 40 | 4,43 |
| 15. Small machinery. | 40 | 4,04 |
| 16. Application of the technology to the construction (insulation). | 40 | 4,85 |
| 17. Application of the technological progress to new needs to the <br> renovation and energy rehabilitation of buildings. | 40 | 4,72 |

The most negatively valued points in relation to innovation and usefulness: "Rule of three" (mathematics); and "knowledge of geography" (science), received low valorisation mainly due to the difficulties in the exercise resolution. Between 20 and $30 \%$ of the trainees that answered about that items remarked the need for improvement. But the general answers in this regard were positive, and it is possible to check in the second part of this report.

On the opposite the better valued items are directly related to the application of the construction tasks related the renovation and energy rehabilitation of the houses. For example the small machinery do not received a good average due to the difficulty for the trainees to set a relation with the specific tasks in this context.

| Question | N | Average |
| :--- | :--- | :--- |
| Information regarding technology of insulation and/or installation. | 40 | 4,66 |
| Theoretical maths concepts (geometric shapes). | 40 | 4,25 |
| Theoretical science concepts (geographic orientation). | 40 | 4,17 |
| Theoretical technological concepts (thermographic camera). | 40 | 3,94 |
| Practical maths exercises (rule of three). | 40 | 4,43 |
| Practical exercises of science (noise and environmental conditions). | 40 | 4,39 |
| Practical exercises of technology (new machinery). | 40 | 4,61 |
| Key competencies procedures consider health and safety good practices. | 40 | 4,83 |

We can highlight the following CONCLUSIONS (after pilot test and discussion with participants):

## Trainers/lecturer

- Although the concept presented are at a basic level approach, the type of teaching exercises presented are very attractive.
- Augmented reality in the training process is a new training tool for all participants and likely in the near future will be widely used.
- The ArKey products (courses) can be and will be used in the training process.

Trainees (workers participants to the qualification courses)

- For some of them some exercises were simple but others did not know how to proceed to solve the proposed exercises.

3. Romania

- The use of new training tools is very attractive, specially for youngest workers.
- Using your phone/tablet for learning, very interesting (to study, testing or to dispose of documentation at anytime).
- Would attend such courses in future. It is interesting in special due to the practical connotation that the theoretical learning outcomes have.


### 3.4 Pictures


4. Portugal

## 4. Portugal

### 4.1 Introduction

The pilot training was held the $24^{\text {th }}$ of September 2015 at CENFIC facilities in Lisbon with the participation of 40 people. The training was conducted by Luis Felipe Oliveira, project technician and trainer.

\section*{Place Trainees Trainers Date <br> | CENFIC, Lisbon. Portugal | 25 | 6 | $24^{\text {th }}$ of September |
| :--- | :--- | :--- | :--- | :--- |}

It is noteworthy that CENFIC brought their pilot to its training center, deciding that the results should be spread to all active courses active at this moment.

As a result we obtained the presence of 40 people interested in testing the tool.
This population was characterized by basic level of trainees (30\%), middle level Trainees (50\%) and trainers/tutors and technical staff (20\%).

### 4.2 Procedure

During the first part of this Pilot Training, people in charge, presented the ARKEY application to the trainees and trainers.

The second part of the training was dedicated to the most practical activities related to the application of augmented reality, that is, to show how this tool works, to show how it has been applied to the acquisition of basic skills and the proposed exercises.

The third part consisted in a summary of the project (aims, others results, EU funding, etc.) as well as an approach to possibilities of transfer of innovation to others related sectors.

Finally, the attendees filled in the ex-post questionnaire in order to know their opinion concerning the app developed. The results are explained in the next section.

### 4.3 Results

The questionnaire was delivered to 31 participants. The results of the survey are shown in the following tables:

| Question <br> Do you think the use of augmented reality in construction is something <br> new and innovative? | $\mathbf{3 0}$ | 3,97 |
| :--- | :--- | :--- |
| Do you think that safety in building works in particular on renovation and <br> energy rehabilitation is a major issue? | 31 | 4,48 |
| Do you think that similar procedures should be developed for other types <br> of works, i.e. civil work activities? | 31 | 4,42 |
| 01. Tutorial for the use of tablets - smartphones. | 30 | 3,23 |
| 02. Triangles and angles operations. | 29 | 3,62 |
| 03. Rule of three. | 28 | 3,61 |
| 04. Geometric shapes. | 28 | 3,82 |
| 05. Measures equivalences. | 29 | 3,83 |
| 06. Materials behaviour. | 29 | 3,97 |
| 07. Knowledge of geography. | 28 | 3,89 |
| 08. Geology knowledge. | 29 | 3,86 |
| 09. Behaviour of the climatology and effects on the edification. | 29 | 3,86 |
| 10. Acoustic properties of the materials. | 28 | 3,86 |
| 11. Thermal properties of the materials. | 29 | 3,83 |
| 12. Ventilation concept and characteristics. | 29 | 3,79 |
| 13. Thermal bridges, how and why avoid them. | 28 | 3,75 |
| 14. New construction machinery. | 29 | 3,76 |
| 15. Small machinery. | 28 | 3,82 |
| 16. Application of the technology to the construction (insulation). | 29 | 3,90 |
| 17. Application of the technological progress to new needs to the <br> renovation and energy rehabilitation of buildings. | 28 | 4,00 |
| Information regarding technology of insulation and/or installation. | 28 | 3,75 |
| Theoretical maths concepts (geometric shapes). | 29 | 3,52 |
| Theoretical science concepts (geographic orientation). | 28 | 3,46 |
| Theoretical technological concepts (thermographic camera). | 28 | 3,93 |
| Practical maths exercises (rule of three). | 29 | 3,59 |
| Practical exercises of science (noise and environmental conditions). | 28 | 3,96 |
| Practical exercises of technology (new machinery). | 28 | 3,82 |
| Key competencies procedures consider health and safety good practices. | 28 | 3,79 |

After a brief analysis we can conclude that the results were assessed satisfactorily, since almost all the items are near 4. The lowest scoring were given to the tutorial for the use of tablets-smartphones as well as the theoretical science concepts concerning the geographic orientation.

After the pilot test a brief discussion took place with participants. The main outcome was that although the system is very good, the less positive point is related to the difficulty in stabilizing the smartphone pointing to the mark (AR-KEY logo) for the application to work correctly.

### 4.4 Pictures



## 5. Italy

### 5.1 Introduction

The pilot training for the assessment of AR.KEY application was held on 21 September 2015 in Vicenza and involved 7 tutors/teachers/trainers and 29 students attending the 3-years vocational training course for construction workers (age from 15 to 18 ).

| Place | Trainees | Trainers | Date |
| :--- | :---: | :---: | :--- |
| CEAP, Vicenza. Italy | 29 | 7 | 21 $^{\text {st }}$ of September |

### 5.2 Procedure

During the first session of the training, from 8.30 to 10.00 a.m. Mr. Mauro Pastore (Director of Centro Edile A. Palladio) and Ms. Lisa Pavan (Vice-director of Centro Edile A. Palladio), who developed the project's outputs during the project lifetime with managerial, research and administrative tasks, presented the ARKEY application to the teachers and trainers Micol Toffanello (guidance counselor for young students), Marco Munaretto (trainer in construction), Luigino Sartori (trainer in construction), Sergio Lazaretti (trainer in construction) and Massimo Guarise (teacher in technical issues).

During the second session of the training, Mr. Mauro Pastore and Ms. Lisa Pavan, with the help of the above-mentioned trained trainers, presented the application to the 29 students, according to the following steps (from 10.00 a.m. to 1.00 p.m.):

STEP 1: Lisa Pavan presented to the students the project's aims and developments, also in terms of transnational cooperation and pointed out the expected outputs from didactical point of view.

STEP 2: The students filled the self-assessment surveys stating their level of skills/ knowledge on the different units of ARKEY application.

The self-assessment results show that no problem are encountered in the use of smart devices, also due the age of the interviewed students and that, in general, the mathematics skills (geometric shapes, angles and triangles operation, equivalences between different measures) as well as the use elevation and small machineries got the higher scores.

It is important to underline the following result of the surveys: on one hand the most part of students answered that they know how to use elevation machineries, but on the other hand, a big number do not know the related risks and the preventive measures to work safely with MEWPs.

Low scores were given also to subjects like: knowledge of technological progress for energy rehabilitations of buildings, application of ETICS systems, knowledge of thermal bridges, geographic orientation of buildings and installation of photovoltaic panels.

Subjects like physics and behaviour of materials, how to use them and ventilation of building stand in the middle rating.

STEP 3: The ARKEY application was presented to the students by showing them a demo video, by projecting the app from a tablet and by letting them experiencing it directly with the device.

STEP 4: The students and the trainers filled the assessment surveys on the pilot training and afterwards an open discussion took place.

### 5.3 Results

The results of the students' assessment surveys are:

| Question | N | Average |
| :--- | :--- | :--- |
| Do you think the use of augmented reality in construction is something <br> new and innovative? | 29 | 3,86 |
| Do you think that safety in building works in particular on renovation and <br> energy rehabilitation is a major issue? | 29 | 4,62 |
| Do you think that similar procedures should be developed for other types <br> of works, i.e. civil work activities? | 29 | 4,54 |
| 01. Tutorial for the use of tablets - smartphones. | 29 | 3,42 |
| 02. Triangles and angles operations. | 29 | 3,81 |
| 03. Rule of three. | 29 | 3,69 |
| 04. Geometric shapes. | 29 | 4,06 |
| 05. Measures equivalences. | 29 | 3,98 |
| 06. Materials behaviour. | 29 | 4,40 |
| 07. Knowledge of geography. | 29 | 3,63 |
| 08. Geology knowledge. | 29 | 3,72 |
| 09. Behaviour of the climatology and effects on the edification. | 29 | 3,89 |
| 10. Acoustic properties of the materials. | 29 | 3,86 |
| 11. Thermal properties of the materials. | 29 | 4,35 |
| 12. Ventilation concept and characteristics. | 29 | 4,14 |
| 13. Thermal bridges, how and why avoid them. | 29 | 3,67 |


| 14. New construction machinery. | 29 | 4,15 |
| :--- | :--- | :--- |
| 15. Small machinery. | 29 | 3,91 |
| 16. Application of the technology to the construction (insulation). | 29 | 4,77 |
| 17. Application of the technological progress to new needs to the <br> renovation and energy rehabilitation of buildings. | 29 | 4,65 |
| Information regarding technology of insulation and/or installation. | 29 | 4,48 |
| Theoretical maths concepts (geometric shapes). | 29 | 3,95 |
| Theoretical science concepts (geographic orientation). | 29 | 3,75 |
| Theoretical technological concepts (thermographic camera). | 29 | 3,40 |
| Practical maths exercises (rule of three). | 29 | 4,14 |
| Practical exercises of science (noise and environmental conditions). | 29 | 4,08 |
| Practical exercises of technology (new machinery). | 29 | 4,42 |
| Key competencies procedures consider health and safety good practices. | 29 | 4,74 |

The results of the students' assessment show that the application had a very positive impact as almost all the "representative" scores stands in the columns rating 4 and 5.

The lowest scores were given to the questions regarding the usefulness of tutorials for the use of smart devices as the students stated they already know how to use this kind of devices.

The discussion also showed a very positive approach to the use of application because it is surely more attractive than conventional teaching methods.

One student suggested setting up this kind of learning paths in the same frame of videogames challenges: when you solve a level (in this case an exercise) you are allowed to access an upper and more difficult level.

Some students asserted that this application is not suitable for aged people, who are probably not familiar enough to the use of smart devices (trainers do not agree!).

The results of the teachers/trainers' assessment surveys are:

| Question | N | Average |
| :--- | :--- | :--- |
| Do you think the use of augmented reality in construction is something <br> new and innovative? | 7 | 4,71 |
| Do you think that safety in building works in particular on renovation and <br> energy rehabilitation is a major issue? | 7 | 5,00 |
| Do you think that similar procedures should be developed for other types <br> of works, i.e. civil work activities? | 7 | 4,29 |
| 01. Tutorial for the use of tablets - smartphones. | 7 | 4,29 |
| 02. Triangles and angles operations. | 7 | 5,00 |
| 03. Rule of three. | 7 | 2,71 |
| 04. Geometric shapes. | 7 | 5,00 |
| 05. Measures equivalences. | 7 | 5,00 |
| 06. Materials behaviour. | 7 | 5,00 |
| 07. Knowledge of geography. | 7 | 4,71 |
| 08. Geology knowledge. | 7 | 5,00 |
| 09. Behaviour of the climatology and effects on the edification. | 7 | 5,00 |
| 10. Acoustic properties of the materials. | 7 | 5,00 |
| 11. Thermal properties of the materials. | 7 | 5,00 |
| 12. Ventilation concept and characteristics. | 7 | 5,00 |
| 13. Thermal bridges, how and why avoid them. | 7 | 5,00 |
| 14. New construction machinery. | 7 | 5,00 |
| 15. Small machinery. | 7 | 4,29 |
| 16. Application of the technology to the construction (insulation). | 7 | 5,00 |
| 17. Application of the technological progress to new needs to the | 7 | 4,86 |
| renovation and energy rehabilitation of buildings. | 7 | 5,00 |
| Information regarding technology of insulation and/or installation. | 7 | 4,86 |
| Theoretical maths concepts (geometric shapes). | 7 | 5,00 |
| Theoretical science concepts (geographic orientation). | 7 | 5,00 |
| Theoretical technological concepts (thermographic camera). | 7 | 5,00 |
| Practical maths exercises (rule of three). | 7 | 5,00 |
| Practical exercises of science (noise and environmental conditions). | 7 | 5,00 |
| Practical exercises of technology (new machinery). | 7 | 5,00 |
| Key competencies procedures consider health and safety good practices. | 7 |  |
|  | 7 | 7 |

Also in this case the results show a very positive assessment of the application and of innovative teaching and training methods in general.

The comments from teachers and trainers arisen during the discussion are:

## POSITIVE ASPECTS

- It is useful for quick technical checks.
- It responds well to the future needs of construction sector both in training and working methods.
- Very intuitive and user-friendly.


## IMPROVABLE ASPECTS

- A bit difficult to turn the pages of the pdf files.


### 5.4 Pictures


6. Germany

## 6. Germany

### 6.1 Introduction

The pilot training was held the $23^{\text {rd }}$ of October 2015 at BZB facilities in Krefeld (Bökendonk 15, 47809 Krefeld, Alemania). The training was conducted by Markus Crone, principal of the training center.

| Place | Trainees | Trainers | Date |
| :--- | :---: | :---: | :--- |
| BZB, Krefeld. Germany | 5 | 6 | $23^{\text {rd }}$ of October |

### 6.2 Procedure

During the first part of this Pilot Training, Markus Crone presented the ARKEY application to the trainers and trainees.

The second part of the training was dedicated to the most practical activities related to the application of augmented reality, that is, to show how this tool works, to show how it has been applied to the acquisition of basic skills and the proposed exercises.

The third part consisted in a summary of the project (aims, others results, EU funding, etc.) as well as an approach to possibilities of transfer of innovation to others related sectors.

Finally, the attendees filled in the ex-post questionnaire in order to know their opinion concerning the app developed. The results are explained in the next section.

### 6.3 Results

The results of the survey are shown in the following tables:

| Question | N | Average |
| :--- | :--- | :--- |
| Do you think the use of augmented reality in construction is something <br> new and innovative? | 11 | 3,91 |
| Do you think that safety in building works in particular on renovation and <br> energy rehabilitation is a major issue? | 11 | 4,55 |
| Do you think that similar procedures should be developed for other types <br> of works, i.e. civil work activities? | 11 | 4,45 |
| 01. Tutorial for the use of tablets - smartphones. | 11 | 3,73 |
| 02. Triangles and angles operations. | 11 | 4,09 |
| 03. Rule of three. | 11 | 3,91 |
| 04. Geometric shapes. | 11 | 4,27 |
| 05. Measures equivalences. | 11 | 4,27 |
| 06. Materials behaviour. | 11 | 4,36 |
| 07. Knowledge of geography. | 11 | 4,20 |
| 08. Geology knowledge. | 11 | 4,10 |
| 09. Behaviour of the climatology and effects on the edification. | 11 | 4,27 |
| 10. Acoustic properties of the materials. | 11 | 4,10 |
| 11. Thermal properties of the materials. | 11 | 4,18 |
| 12. Ventilation concept and characteristics. | 11 | 4,11 |
| 13. Thermal bridges, how and why avoid them. | 11 | 4,27 |
| 14. New construction machinery. | 11 | 4,20 |
| 15. Small machinery. | 11 | 4,09 |
| 16. Application of the technology to the construction (insulation). | 11 | 4,00 |
| 17. Application of the technological progress to new needs to the | 11 | 4,36 |
| renovation and energy rehabilitation of buildings. | 11 | 3,91 |
| Information regarding technology of insulation and/or installation. | 11 | 4,18 |
| Theoretical maths concepts (geometric shapes). | 11 | 3,64 |
| Theoretical science concepts (geographic orientation). | 11 | 3,82 |
| Theoretical technological concepts (thermographic camera). | 11 | 4,09 |
| Practical maths exercises (rule of three). | 11 | 4,27 |
| Practical exercises of science (noise and environmental conditions). | - | - |
| Practical exercises of technology (new machinery) |  |  |
| Key competencies procedures consider health and safety good practices. | 11 | 4,18 |
|  |  |  |

[^0]The results from the German pilot experience were highly satisfactory, since almost all the items overcome 4 points. The lowest scoring were given to the tutorial for the use of tablets-smartphones as well as the theoretical science concepts concerning the geographic orientation.

### 6.4 Pictures



ANNEX

## ANNEX 1. Self-assessment survey deployed on the APP

## Instructions

Please fill in (Indicate by a cross the more representative box for your competence level).

MARK YOUR LEVEL OF PROFICIENCY from 1 to 10. Please be honest and try to assess sincerely your own knowledge level concerning the proposed items, taking in account the following scale.

|  | do not know anything about the issue |
| :---: | :---: |
| 3 | I know the topic but not for its application in construction. |
| 4 |  |
| 5 | I know the topic in theory but cannot remember its practical application, I've forgotten. |
| 6 |  |
| 7 | I know this topic in practice but I do not know the theoretical concept. |
| 8 |  |
| 9 | I know perfectly the topic both the theoretical and the practica utility and its application in worksites. |
| 10 |  |

## COMMON SKILLS/MATHEMATIC SKILLS/SCIENCE SKILLS/TECHNICAL AND TECHNOLOGICAL KNOWLEDGE

| Subject/Scale | $1-2$ | $3-4$ | $5-6$ | $7-8$ | $9-10$ | LO |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Using of Smartphone and tablets or other <br> devices alike. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 1 |
| Angles operations (calculation for a ramp). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 2 |
| The measuring of an angle (procedure and <br> tool). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 2 |
| A triangle and types. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 2 |
| Rule of three to trace an angle of 900. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 3 |
| Rule of three to solve a proportion calculus. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 3 |
| Geometric shapes. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 4 |
| Equivalences between several measures <br> (m³ - litres). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 5 |
| Measurement pattern - name - symbol of <br> the measure unit | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 5 |
| Identification within the building site of <br> materials behaviour against cold, fire, <br> dilatation, etc. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 6 |
| Know how to use different materials in the <br> constructive process, and the better <br> procedure. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 6 |
| Knowledge of geography (physical <br> geography: how the hot appear...?). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 7 |
| The different incidence of the sun in <br> summer and winter. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 7 |
| The better position and inclination of a <br> photovoltaic panel depending on the <br> geographical orientation. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 7 |
| Knowledge of geology. The different type of <br> soils and the influence in a work. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 8 |
| Soils formed by different types of <br> aggregates (about gravel). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 8 |
| Characteristics of the soil plasticity, <br> tougness, moisture) and the influence on <br> the building's structural components. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 8 |
| Knowledge of climatology. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 9 |
| The climate impacts on the built <br> environment (facade orientation, the better <br> geographical situation, the type of building <br> cover...) | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 9 |


| Subject/Scale | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 | LO |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| The noise and the acoustic conditions <br> (noise level) uncomfortable for human <br> being. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 10 |
| Knowledge of acoustic properties of <br> materials. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 10 |
| Solutions for sound-noise proofing <br> structures and materials. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 10 |
| Knowledge of thermal properties of <br> materials. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 11 |
| How the adequate combination of <br> materials helps in the thermal isolation of a a <br> house. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 11 |
| Knowledge of building ventilation. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 12 |
| How and why the air flows thru the rooms <br> of a house. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 12 |
| Natural and mechanical ventilation. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 12 |
| Knowledge of thermal bridges. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 13 |
| The main risks related to working at height <br> on a MEWP. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 14 |
| The preventive measures to work safety on <br> height on a MEWP. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 14 |
| Using of new construction elevation and <br> transportation machinery. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 14 |
| Using of new construction small machinery. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 15 |
| The main risks related the use of portable <br> machinery. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 15 |
| The measures to reduce or avoid the related <br> risks. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 15 |
| Using of new technologies applied to <br> building maintenance and renovation <br> (ETICs - External Thermal Isolation System; <br> fastening to the supporting surface). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 16 |
| Using of technological lporgresses. Energy <br> rehabilitation of buildings (thermographic <br> camera). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | 17 |

## ANNEX 2. Assessment survey after pilot training

The following survey assesses the relevance and utility of the ARKEY system. The assessment consists in the evaluation of each of the proposed items from 1 to 5: Being 1 the worst scoring and 5 the best one.

Mark your level of agreement or disagreement with the following questions.

| Item | Question | 1 | 2 | 3 | 4 | 5 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Do you think the use of augmented reality in construction is something new and innovative? | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 2 | Do you think the safety issue in the trade tasks works in a transversal way for reformation or energy rehabilitation is a major issue? | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 3 | Do you think that similar procedure should be developed for other work , i.e. civil work activities? | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| Please asses whether the contents of this course are innovative and useful to improve or to understand the key competencies and its application to the construction sector. |  |  |  |  |  |  |
| 4 | 01. Tutorial for the use of tablets - smartphones. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 5 | 02. Triangles and angles operations. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 6 | 03. Rule of three. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 7 | 04. Geometric shapes. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 8 | 05. Measures equivalences. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 9 | 06. Materials behaviour. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 10 | 07. Knowledge of geography. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 11 | 08. Geology knowledge. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 12 | 09. Behaviour of the climatology and effects on the edification. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 13 | 10. Acoustic properties of the materials. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 14 | 11. Thermal properties of the materials. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 15 | 12. Ventilation concept and characteristics. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 16 | 13. Thermal bridges, how and why avoid them. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 17 | 14. New construction machinery. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 18 | 15. Small machinery. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 19 | 16. Application of the technology to the construction (isolation). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 20 | 17. Application of the technological progress to the new needs of the reformation and rehabilitation of buildings. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |

Please asses the innovation and utility of the learning outcomes (lessons and exercises).

| 21 | Report on the technology of isolation or installation. | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- |
| 22 | Theoretical maths concepts (geometric shapes). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 23 | Theoretical science concepts (geographic orientation). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 24 | Theoretical technological concepts (thermographic camera). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 25 | Practical maths exercises (rule of three). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 26 | Practical exercises of science (noise and environmental <br> conditions). | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| 27 | Practical exercises of technology (new machinery). |  |  |  |  |  |
| 28 | Manual of reformation and energy rehabilitation key <br> competencies procedures are based on health and safety <br> good practice (is included the H\&S in the manual)? | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |

¿Do you have any additional comments on the procedures developed?
$\qquad$
$\qquad$
------------------------------------------------------------
If you are interested in receive further information about the Project, please give us your contact details below:
$\qquad$
$\qquad$
$\qquad$
$\qquad$

FUNDACIÓN LABORAL DE LA CONSTRUCCIÓN

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ENTE NAZIONALE PER IA PROFESSIONAIE NEIL'EDILIZIA

Cenfic
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## BZB

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[^0]:    ${ }^{1}$ Due to a printing error this item was not answer by participants.

