Effectiveness of a Train-the-trainer Initiative Dealing with Free and Open Source Software for Geomatics

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ABSTRACT

In the summers of 2007 and 2008 we conducted a two week train-the-trainer initiative dealing with free and open source geomatics tools (FOSS4G). The total number of participants was 43 coming mainly from research, educational and government settings in developing countries. They were exposed to the concepts of spatial data modelling and analysis in the context of Land Evaluation and Land Use Planning and were introduced in the overall FOSS4G-domain. Theory was put in practice using the FOS-softwares QGIS and GRASS and a geospatial database covering a small wathershed in the Ecuadorian Andes. Trainees did not only work with the ready-to-use functionality of these free softwares but were also introduced to the possibilities the open source character offers for community-based code development for software customization and extension. In order to promote the further spreading of the gained knowledge and experience, all course materials (presentations, reference documents and geodatasets) were made available to the participants in an editable format under the open source creative common license. At the end of the training 96% (2008) to 85% (2007) of the participants stated the firm intention to incorporate FOSS in their professional practice, to re-use the distributed materials and to further spread the gained knowledge. From a questionnaire survey 4 months after the 2008-training and 16 months after the 2007-training we found that almost every respondent confirmed his or her intentions but less than 50% (2007) and about 50% (2008) had effectively started to put the intentions into practice to a lesser or larger extent. Not the FOSS sensu stricto is re-used most but rather the documents. Re-use of the geodata is more limited. Documents are used mainly for personal reference. Only a limited number of attempts have been made to adapt and re-use them in local teaching and training. A majority of the respondents is using the FOSS for self-study but some have also incorporated them in teaching and training programmes. Despite the apparent fairly weak effectiveness of the initiative, the impact seems to be remarkably higher than for a comparable initiative we conducted in 2005 focusing on commercial and closed source software (CCSS4G). From the 15 participants, only 3 confirmed 40 months after the training, that they re-use the documents while 1 individual is using the CCSS4G. The latter low figure is due the impossibility for many trainees to access the CCSS4G. We conclude from these experiences that the effectiveness of a train-the-trainer initiative geared towards the developing world is modest but that the availability of FOSS4G together with supporting materials after a training clearly leads to more intensive re-use than when only documents accompanying a CCSS4G are made available.

INTRODUCTION

Since about a decade there is rapid development of free and open source software tools for geomatics (FOSS4G). Whereas initially the tools were geared towards experts and were command line-based, they evolved towards toolboxes with user friendly interfaces which are increasingly appreciated by user communities. In addition, the toolboxes gained functionality often offering an operational professional environment for spatial data modelling, analysis and publishing (Neteler, 2008). The FOSS4G toolsets and solutions available on the market today cover a wide variety of products belonging to several functional groups: GIS/Image Processing desktop applications, database management systems, server applications, metadata catalogues and development libraries

(Wawer, 2008) implemented in various software development languages (Ramsey, 2007). In the meantime the demand for FOSS4G-solutions has grown to a point where FOSS4G-based businesses take off (Maesen, 2008; OSGeo, 2007b).

Along with the growing interest for FOSS4G in various geospatial user communities, the need arised for adequate training. Several bodies started to offer training in the use and development of FOSS4G (OSGeo, 2007b), often as a supplement to training in commercial closed source software (CCSS4G). In most cases the FOSS4G-training materials are released under the Creative Commons License, which grants the right for re-use in further training and related activities (OSGeo, 2007a). In line with this rationale, we conducted in the summers of 2005, 2007 and 2008 a two week training initiative, a so called (in Dutch language) "Kort OpleidingsInitiatief" or KOI, dealing with the possibilities and limitations of GI-technology for support of land evaluation activities and for formulation, implementation and adjustment of land use plans. In all cases participants were predominantly from countries in Latin-America, Africa and South-East Asia. Whereas in 2005, the renowned commercial and closed softwares for geomatics (CCSS4G) ArcGIS (http://www.esri.com/) and ERDAS-Imagine (http://www.erdas.com/) were used, we shifted to the free and open source software (FOSS4G) Quantum-GIS (http://www.qgis.org/) and GRASS (http://grass.itc.it/) from the 2007-edition onwards. From a questionnaire survey conducted at the end of the 2005 and 2007 courses we found that the participant satisfaction was clearly higher for the latter (Abu el Nasr and Van Orshoven, 2008). Although the particular set up of both courses did not allow to attribute the increased satisfaction exclusively to the substitution of CCSS4G by FOSS4G, there were strong indications that this shift was experienced by the participants to be beneficial mainly with a view to the unlimited possibilities for re-use of the software. Immediately after the closure of the 2007 and 2008 initiatives and before returning to their home countries, almost all participants stated the firm intention to incorporate FOSS in their professional practice. They also confirmed their readiness to re-use the distributed presentations and text materials and geodatasets for further spreading of the gained knowledge and skills. By means of a follow-on questionnaire several months after the closure of the KOI, we wanted to address the question of effectiveness of these and similar training initiatives. We tackled this question by comparing the intentions of participants for re-use of software, documents and datasets as recorded immediately after the training with the use they effectively have made and are making 4 to 40 months after the KOI.

MATERIALS AND METHODS

Training initiatives

The three training initiatives or KOI of which we examine the effectiveness have been designed and dispatched along the same lines of content and format but are clearly not identical. Throughout the three initiatives, Modules 1 and 2 can be considered to encompass similar content although less time was devoted to them in the later training editions so that more time became available for social activities (2007) and for social activities and two additional but limited modules (2008). Table 1 presents an overview of the diagnostic characteristics of each of the three KOI.

	2005	2007	2008
Title	GIS and Earth Remote Sensing for physical land evaluation	Land evaluation with Free and OpenSource geomatics tools	Free and Open Source geomatics tools for land evaluation and land use planning
Period	20-jun-05 to 2-jul-05 (12 class days)	27-aug-07 to 7-sep-07 (10 class days)	18-aug-08 to 29-aug-08 (10 class days)
Type	Train-the-User	Train-the-Trainer	Train-the-Trainer
Total number of participants	15	20	23
Number of scholars (all modules)	12	11	12
Structure	Module 1 (6 days): Basics of GIS and its application in physical land evaluation Module 2 (6 days): Basics of remote sensing for GIS and its application in physical land evaluation	Module 1 (5 days): Concepts and functions of GIS for land evaluation; Using FOSS4G QGIS and its GRASS-plugin Module 2 (5 days): Concepts and functionalities of remote sensing and image processing; Using FOSS4G GRASS	Module 1 (4 days): QGIS and its GRASS-plugin as a FOSS4G-tool for land evaluation and land use planning: Module 2 (3 days): GRASS as a FOSS4G-tool to integrate remotely sensed data in GIS for land evaluation and land use planning Module 3 (2 days): Customising QGIS-software Module 4 (1 day): Evaluation of FOSS4G-solutions
Software	ArcGIS 8.3 ERDAS-Imagine 8.6	Quantum GIS 0.8.1 Titan GRASS 6.2.2	Quantum GIS 0.11.0 Metis GRASS 6.3.0.4 MS4W 2.2 Python 2.5
Geodatasets covering	Various areas in Belgium	Tabacay river basin in the southern Andes of Ecuador	Tabacay river basin in the southern Andes of Ecuador

Table 1: Characteristics of studied training initiatives.

All three KOI were organized at the premises of the Katholieke Universiteit Leuven in Belgium and have been sponsored by VLIR-UOS, the University Development Cooperation section of the Flemish interuniversity council. The VLIR-UOS-contribution covered part of the organizational cost on the one hand and the participation, travel, board and lodging of a total of 35 scholars on the other hand. Scholars were coming exclusively from countries categorized by OECD as 'least developed', 'other Low Income countries' or 'Lower Middle Income countries'. All other participants paid a participation fee. The majority of participants from the latter category was from a developing country and was delegated by an interuniversity cooperation project. The others were Belgian students or researchers. Candidate participants were recruited by means of general web announcements and by targeted communication with universities and other overseas research partners of K.U.Leuven.

In 2005, the selection of scholars was based on the candidates' prior experience in the land evaluation and/or land use planning domain, prior knowledge of working with maps and PC's, motivation, proficiency with the English language and availability of two recommendation letters. For the 2007- and 2008-issues of the training, candidates were evaluated on the same basis but more emphasis was put on the candidate's motivation and perspectives for further spreading the gained knowledge to students, colleagues or fellow-professionals.

Questionnaire surveys

At the end of each module, participants were given the opportunity to express appreciation, evaluate utility and usability and formulate points of attention. In 2007 and 2008 they were asked explicitly whether they envisaged to re-use the course materials in their professional educational, research or business practice. At this stage no distinction was made between the re-use of software, data or documents.

Early December-2008, all participants to each of the three KOI were sent by e-mail a follow-on questionnaire, enquiring about the effective use made of the materials since the end of the training. At this stage, separate questions were asked by module about software, data and documents. Data about the response to the questionnaires is given in Table 2. The identification of individual respondents is not available. For the follow-on questionnaire a distinction can be made between scholars and other participants. All respondents to the follow-on questionnaire provided information about all modules so that the response rates are identical.

		2005		2007		2008	
		End of KOI	End of KOI+40 months	End of KOI	End of KOI +16 months	End of KOI	End of KOI+4 months
Module#							
M1	All	100%	27%	85%	40%	96%	61%
	Scholars	-	33%	-	55%	-	67%
M2	All	93%	27%	90%	40%	78%	61%
	Scholars	-	33%	-	55%	-	67%
M3	All	°	°	°	°	88%	61%
	Scholars	°	°	°	°	-	67%
M4	All	°	°	°	°	92%	61%
	Scholars	°	°	°	°	-	67%

Table 2: Response to questionnaires, relative to total number of participants and total number of scholars (%, ° Not Applicable; - Not Available).

Both the end-of-KOI and the follow-on questionnaires of 2007 and 2008 encompassed a question regarding the re-use of the documents, data and software supplied through the training. For 2005, this detailed information was enquired only in the follow-on questionnaire. At the end of KOI 2005, the question pertained to 'training materials' in general.

Processing of questionnaire data

The questionnaires returned binary data (Yes/No) where it regards the re-use of software, data and documents. They also provided descriptive details about the type of re-use: self-study, personal reference, teaching (in formal education programmes), training (in ad-hoc initiatives), demonstration, research and other operational tasks. First the frequency of positive responses were computed and expressed relative to the total number of responding participants on the one hand and the total number of responding scholars on the other hand. In addition, percentages are computed assuming that the non-respondents have not re-used the materials, by normalization by the total number of participants resp. scholars. For the positive responses, the frequency of the types of re-use is determined. For the negative responses, the reasons mentioned for no re-use are counted. The further discussion of these results is limited to the responses of the scholars. Since the scholars have been selected by the organizers based on known and standardized criteria, since all of them originate from developing countries and since all of them participated in all modules, this group is likely to represent a more homogeneous population than all participants pooled. Only data regarding the modules 1 and 2 for each of the 3 training issues are processed. Modules 3 and 4 in 2008 have no equivalent components in 2005 nor 2007. No statistical assessments and inferences are made due to the low number of data points.

RESULTS

Table 3 presents the relative frequencies of positive responses regarding re-use of overall course materials as expressed by the participants at the end of each KOI. Table 4 gathers the positive responses for documents, data and software separately, based on the follow-on questionnaires.

Re-use of:	Module	Frequency of positive response normalized by number of:	2005	2007	2008
			End of KOI	End of KOI	End of KOI
Overall training material	M1	Participants	67%	85%	96%
		Responding participants	85%	100%	96%
	M2	Participants	60%	100%	95%
		Responding participants	75%	100%	95%

Table 3: Frequency of positive responses at end of KOI regarding intended re-use of training materials, expressed relatively to (1) all participants and (2) all responding participants (- Not Available)

Re-use of	Module	Frequency of positive response normalized by number of:	2005	2007	2008
			End of KOI+40 months	End of KOI+16 months	End of KOI+4 months
Documents	M1	Participants	20%	25%	57%
		Responding participants	75%	63%	93%
		Scholars	17%	36%	58%
		Responding scholars	67%	67%	88%
	M2	Participants	20%	25%	57%
		Responding participants	75%	63%	93%
		Scholars	17%	36%	58%
		Responding scholars	67%	67%	88%
Data	M1	Participants	°	20%	52%
		Responding participants	°	50%	86%
		Scholars	°	18%	50%
		Responding scholars	°	33%	75%
	M2	Participants	°	15%	30%
		Responding participants	°	38%	50%
		Scholars	°	18%	33%
		Responding scholars	°	33%	50%
Software	M1	Participants	7%	30%	48%
		Responding participants	25%	75%	79%
		Scholars	0%	36%	42%
		Responding scholars	0%	67%	63%
	M2	Participants	7%	15%	52%
		Responding participants	25%	38%	86%
		Scholars	8%	18%	58%
		Responding scholars	33%	33%	88%

Table 4: Frequency of positive responses in the follow-on survey regarding re-use of documents, data and software, expressed relatively to (1) all participants, (2) all responding participants, (3) all scholars and (4) all responding scholars (° Not applicable)

In Tables 5, 6 and 7 the relative frequencies of the type of re-use of the Module1-documents, the Module1-geodatasets and the Module1-software which is being made and/or which is planned to be made in the future by the responding scholars is given. Similar data for Module 2 are not shown.

Type of re-use	2005		2007		2008	
	End of KOI+40 months	Future	End of KOI+16 months	Future	End of KOI+4 months	Future
Not any	25%		33%		13%	
Personal reference	25%		33%		25%	
Self-study					38%	
Teaching	50%		17%			25%
Training						13%
Demonstration					13%	
Operational tasks			17%			
Research					13%	
Not specified		100%		100%		63%
Total	100%	100%	100%	100%	100%	100%

Table 5: Relative frequency of type of re-use made of or planned for the Module1 documents by the responding scholars.

Type of re-use	2005		2007		2008	
	End of KOI+40 months	Future	End of KOI+16 months	Future	End of KOI+4 months	Future
Not any			67%		38%	
Personal reference	°	°			13%	
Self-study	°	°			38%	
Teaching	°	°			13%	25%
Training	°	°	33%			
Demonstration	°	°				
Operational tasks	°	°				
Research	°	°				
Not specified	°	°		100%		75%
Total			100%	100%	100%	100%

Table 6: Relative frequency of type of re-use made of or planned for the Module1 geodatasets by the responding scholars (° Not Applicable).

Respondents who have not re-used the materials mention almost unanimously lack of time and, for software, lack of adequate hardware facilities as the major reason (data not shown). Not any use has been reported in which FOSS4G-code is developed.

DISCUSSION

The response rate to the questionnaires by the participants at the end of KOI is obviously high and is comparable among the 2005-, 2007- and 2008-issues (Table 2). Not surprisingly, the response to the follow-on questionnaire is inversely correlated with the time lag since the training. Scholars tend to respond more than non-scholars.

According to Table 4, there is a slight tendency for scholars to re-use the documents less frequently than the other participants. In addition, documents are re-used more by responding scholars than software is. Datasets are least re-used. Software of the CCSS4G-type (2005) is almost not used due to lack of access to it.

Documents are re-used by 67% of responding scholars of 2005 and 2007 whereas 88% of responding scholars of 2008 do so (Table 4). They are mainly re-used for personal reference, for self-study and for teaching (Table 5). Demonstration, operational tasks and research are each mentioned by a single respondent only over the 3 years. Teaching and training are mentioned for future use by some 2008 respondents.

Data have mainly been re-used by responding scholars for personal reference, self-study, teaching and training by the 2007 and 2008 scholars (Table 6). Teaching is also mentioned for future use. The fact that the distributed datasets cover territories in Belgium or the southern Andes region of Ecuador makes their usefulness of course limited for operational and related tasks in other parts of the world.

CCSS4G-software is used by not any responding scholar since the 2005-training. 67% of the 2007-responding scholars and 63% of the 2008-responding scholars have however already used the FOSS4G in the 16 resp. 4 months period after closure of the KOI (Table 4). Self-study is the major purpose for which the FOSS4G is used but also the fulfillment of operational and research tasks has been mentioned (Table 7).

There is no apparent difference in the re-use of materials of Module 1 (GIS) as compared to those of Module 2 (Image processing for GIS) (Table 4). The seemingly more complex content of Module 2 has not lead to more limited or more intensive re-use compared to the more basic Module 1.

Type of reuse	2005		2007		2008	
	End of KOI+40 months	Future	End of KOI+16 months	Future	End of KOI+4 months	Future
Not any	100%		33%		38%	
Personal reference						
Self-study			50%		38%	
Teaching						13%
Training						
Demonstration						
Operational tasks			17%		13%	
Research					13%	
Not specified		100%		100%		88%
Total	100%	100%	100%	100%	100%	100%

Table 7: Relative frequency of type of re-use made of or planned for the Module1 software by the responding scholars (CCSS4G in 2005 and FOSS4G in 2007 and 2008).

From these experiences it is clear that practical obstacles (e.g., lack of time or hardware) explain partly the limited re-use of the materials by the participants in general and by the scholars in particular. Since we could not find data about effectiveness and impacts of other training or educational initiatives regarding CCSS and/or FOSS to compare our results with, it is hard to assess whether our findings are in line with a more general situation or are rather exceptional. It is obvious however that, as for any vocational training initiative, the effectiveness and impact is related to the immediate usability for the participant. This points again to the importance of the recruitment procedure on the one hand and to the need for even more tailor-made training on the other hand.

CONCLUSIONS

Although almost every participant confirmed at the end of KOI the intention and readiness to re-use the distributed documents, data and software in his or her educational, research or other professional practice, the effective re-use of these materials is much more limited 40, 16 resp. 4 months after the end of KOI. CCSS4G is not used due to a lack of access to this type of software. The re-use of FOSS4G is more pertinent. A majority of the responding scholars is using the FOSS for self-study but some have also incorporated it in teaching and training programmes. No projects have been reported in which additional software code is developed. Documents accompanying the softwares and explaining and illustrating concepts are re-used more than the software sensu stricto, especially where it regards FOSS4G. Joint availability of documentation and software seems to foster more the re-use of the documents than in the case the related software is not easily available (CCSS4G). Documents are used mainly for personal reference. Only a limited number of attempts have been made to adapt and re-use them in local teaching and training. Logically, the geodatasets used during the training are re-used only for enhancement of the software skills. We conclude from these experiences that the effectiveness of a train-the-trainer or train-the-user initiative geared towards the developing world is modest but that the availability of both (FOSS4G) software and accompanying materials after a course clearly leads to more intensive re-use than when only documents supporting the use of -otherwise not distributed- CCSS4G are available. Although not evident to put in practice, more targeted recruitment of participants and more individualized training content and approach may be keys to increase effectiveness.

ACKNOWLEDGEMENTS

The authors sincerely thank the University Development Cooperation section of the Flemish Inter-university Council (VLIR-UOS) for supporting the three training initiatives.

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