A Study of Usability of Sketching Tools Aimed at Supporting Prescriptive Sketches

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Overview Introduction Discussion Hypothesis Questionnaire Results Conclusions

Prescriptive sketches are usually drawn, *after* conceptual design is over, to prepare the creation of digital 3D models.



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Prescriptive sketches are usually drawn, after conceptual design is over, to prepare the creation of digital 3D models.

Designers and draftsmen use them as "screenplays" that guide the creation of the final 3D model.







Overview Introduction Discussion Hypothesis Questionnaire Results Conclusions

Prescriptive sketches are still paper-and-pencil.

in spite of the existence of some academic or even commercial, computer tools.



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Prescriptive sketches are still paper-and-pencil.

in spite of the existence of some academic or even commercial, computer tools.

In this paper, we defend the hypothesis that this is because current computer tools are less usable than paper-and-pencil sketches and do not posses significantly improved functionality.



Overview Introduction Discussion Hypothesis Questionnaire Results Conclusions According to the classification by Ferguson [Fer92], we distinguish:

✓ *thinking sketches* used to focus and guide non-verbal thinking;

talking sketches employed to support discussion on the design with colleagues;

prescriptive sketches applied to give
 instructions to the draftsman who is in
 charge of making the final drawing.



Overview Introduction Discussion Hypothesis Questionnaire Results Conclusions According to the classification by Ferguson [Fer92], we distinguish:

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talking sketches employed to support discussion on the design with colleagues;

prescriptive sketches applied to give instructions to the draftsman who is in charge of making the final drawing.



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Overview Introduction Discussion Hypothesis Questionnaire Results Conclusions Prescriptive sketches clearly differ from other sketches as they contain:

 \checkmark Many standardized conventions (like dimensions)

 \checkmark Cutted views with hatchings

 \sqrt{A} large etcetera of icons and symbols

















Discussion

Results













Overview Introduction **Discussion** Hypothesis Questionnaire Results Conclusions Apart from the advantages of paperless office, "plain" digital prescriptive sketches do not solve any *real* problem.



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since paper-and-pencil sketching is

 simpler,
 polyvalent and
 well suited
 for giving instructions to the draftsman in charge of making the final drawing or 3D model
 and general and automatic and general and automatic



Overview Introduction **Discussion** Hypothesis Questionnaire Results Conclusions It can be concluded that achieving or even enhancing the usability of paper-and-pencil is a key issue for the success of digital prescriptive sketching.



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Following this assumption, we did not investigate existing research tools for sketch input because our pursuit was digital sketches obtained in a simple virtual paper and pencil scenario.



Overview Introduction **Discussion** Hypothesis Questionnaire Results Conclusions It can be concluded that achieving or even enhancing the usability of paper-and-pencil is a key issue for the success of digital prescriptive sketching.

Following this assumption, we did not investigate existing research tools for sketch input because our pursuit was digital sketches obtained in a simple virtual paper and pencil scenario. i.e., sketch space should be deliberately minimalist [PA02].

However, adding some extra functionality, without suffering any reduction in usability, should increase the acceptance of those tools!



Hypothesis

Overview Introduction Discussion **Hypothesis** Questionnaire Results Conclusions Our hypothesis is that the less intrusive the CAS tool, the better for the designer.



Hypothesis

Overview Introduction Discussion **Hypothesis** Questionnaire Results Conclusions

Our hypothesis is that the less intrusive the CAS tool, the better for the designer.

We understand "intrusive" as equivalent to attracting the attention of the designer.

In other words, an intrusive interface is permanently requiring the user to do things,

and tends to gain more and more control on the process of fixing geometry of a new shape or design



Overview Introduction Discussion Hypothesis **Ouestionnaire** Results Conclusions We decided to simulate a non-intrusive CAS tool by asking the interviewed people to draw a sketch on a tablet PC with the least intrusive digital drawing tool we could find.

It was compared against the typical 2D CAD sketching capabilities



Overview Introduction Discussion Hypothesis **Questionnaire** Results Conclusions We decided to simulate a non-intrusive CAS tool by asking the interviewed people to draw a sketch on a tablet PC with the least intrusive digital drawing tool we could find.

We opted by Microsoft's PAINT, but reducing its set of tools to just paintbrush and rubber.

It was compared against the typical 2D CAD sketching capabilities

UGS's SolidEdge, was chosen because of its availability and the familiarity that many of the interviewed had with it.



Overview Introduction Discussion Hypothesis **Ouestionnaire** Results Conclusions The respondents were asked to compare prescriptive sketching done in three different scenarios:

Hand (H) Paint+tablet (P/t)

SolidEdge (S/E)



Overview Introduction Discussion Hypothesis **Ouestionnaire** Results Conclusions We selected four sketches, intended to be representative of the most current sketch types, while being simple enough to allow completing the test in one hour





Overview Introduction Discussion Hypothesis **Ouestionnaire** Results Conclusions Our population was conceived as a mixture of experts (E's) and beginners (B's):

²5 8 teachers of engineering design and CAD,

 B'_5 22 first year engineering students; who gave us the point of view of beginners

Our aim in chosing those populations was to try to separate the "familiarity" issue from the underlying "usability" issue.

Some of our experts are mostly used to paper and pencil and dislike current software, while other are real experts in CAD teaching.



Our students have been taught in a computer-dominant environment, and feel less comfortable with paper and pencil.

Overview Introduction Discussion Hypothesis **Ouestionnaire** Results Conclusions

Finally, the respondents had to answer two groups of questions.



Overview Introduction Discussion Hypothesis **Ouestionnaire** Results Conclusions

Arrange the four sketches, scoring them from easiest (1) to most difficult (4).

Arrange, from most important (1) to less important (4), the following criteria to determine which is the most difficult sketch:

a) the one that contains more lines

b) the one that contains more curves

c) the one that is less symmetrical

d) the one that contains more angles

Signal the tool (H if hand, P if Paint/tablet or S if SolidEdge) with which you have obtained the best version of every sketch.

Arrange the tools (Hand, Paint/mouse, Paint/tablet and SolidEdge) scoring them from the easiest (1) to the most difficult (4).



Overview Introduction Discussion Hypothesis **Ouestionnaire** Results Conclusions

Enumerate the main advantages of hand-made drawings.

Enumerate the main advantages of Paint with tablet.

Enumerate the main differences between Paint with tablet and Paint with mouse.

Enumerate the main advantages of SolidEdge.

Add any observation you consider to be relevant.



Results

Overview Introduction Discussion Hypothesis Questionnaire **Results** Conclusions First, it was checked that the orded in which the respondents made the drawings did not significantly affect the results

Because the "pseudo-random" sequence that we introduced seemed to be enough to prevent a dominant order

	Sequ	lence	Ð												
	Hand	d (H)			Paint	t/tabl	et (P/	t)	Solic	IEdge	e (S/E)	P/m		
Respondent	A	в	с	D	A	в	с	D	A	A					
B01	1	2	3	4	7	8	9	10	5	6	11	12	13		
B02	3	5	7	9	10	11	12	13	2	4	6	8	1		
BCG	5	6	7	8	1	2	3	4	9	10	11	12	13		
в04	1	11	12	13	2	3	4	5	7	8	9	10	6		
B05	5	6	7	8	1	2	3	4	10	11	12	13	9		
B06	5	7	8	9	13	12	10	11	1	2	3	4	6		
B07	10	11	12	13	6	7	8	9	1	2	3	4	5		
B08	1	2	3	4	8	9	10	11	5	6	7	13	12		
B09	2	3	4	5	6	7	8	9	10	11	12	13	1		
B10	10	11	12	13	1	2	3	4	5	6	7	8	9		
B11	10	11	12	13	1	2	3	4	5	6	7	8	9		
B12	9	10	11	12	1	2	3	4	5	6	7	8	13		
B13	1	2	3	4	9	10	11	12	5	6	7	8	13		
B14	10	11	12	13	5	6	7	8	2	3	4	9	1		
B15	1	2	3	4	10	11	12	13	6	7	8	9	5		
B16	1	2	3	4	10	11	12	13	6	7	8	9	5		
B17	9	10	11	12	1	2	3	4	5	6	7	8	13		
B18	10	13	12	11	6	9	7	8	2	3	4	5	1		
B19	1	2	3	4	5	6	7	8	9	10	11	12	13		
B20	1	2	3	4	10	11	12	13	5	6	7	8	9		
B21	6	7	8	9	10	11	12	13	2	3	4	5	1		
B22	1	2	3	4	5	6	7	8	9	10	11	12	13		
E01	9	10	11	12	5	6	7	8	1	2	3	4	13		
E02	4	7	10	13	2	6	9	12	1	5	8	11	3		
EC3	1	2	4	5	3	7	8	9	10	11	12	13	6		
E04	6	7	8	9	1	2	3	4	10	11	12	13	5		
E05	1	2	3	4	5	6	7	8	9	10	11	12	13		
E06	1	2	3	4	9	10	11	12	5	6	7	8	13		
E07	1	2	3	4	5	6	7	8	9	10	11	12	13		
E08	3	4	6	7	10	11	12	13	1	2	5	8	9		
E09	1	2	3	4	5	6	7	8	10	11	12	13	9		
Avera ge	4,2	5,7	6,8	7,8	5,6	6,8	7,6	8,7	5,5	6,7	8,0	9,4	8,2		
	1	4	7	9	3	6	8	12	2	5	10	13	11		



Results

Overview Introduction Discussion Hypothesis Questionnaire **Results** Conclusions

Then, we tabulated the general results:

	Prev	ious		Execution score							Time															Easy	(1)		Most	(1)			Best ı	result	Simplex (1)												
	expe	rien	nce Hand (H)				Paint/tablet (P/t)					SolidEdge (S/E) P/m					m H	land	(H)				Paint	/table	t (P/t)			SolidEdge (S/E)					to dif	o difficult (4)			to less difficult (4)			for every sketch			to complex (4)				
ij					. ,							,					. ,	Т	+	+		. ,							Т	+			,	Г	\vdash			.,			ŝ	<u> </u>		,			<u> </u>
ande								s					8	(Vd					8						ag					8				8					8	JN68	mme	gles					
as b c		Pň	S/F		Р	~		/eraj	A	D	c	п	/erai	SS(H		Р	c		/era	, ,		D	~ 1	۱ _م	/era(D	<u>с</u> п		era,			п	/era				п	li li	rec	SS SJ	ore a	A D	с п	н	P/m P	# S/F
<u>2</u>	2.66	0	24	2	2	2	2	- E A	2	2	2	2	¥ 20	E P P	2	25	26 7	26	₹ 24	20	2	45	6	<u> </u>	÷.	A 0.5	12	12	14 4	£ /	0.5	10	4 10	¥ oo	A 0.0	1 1		2 4	ž	ž	2	ž	A D	0.0	1	4	
D01	3,30	0	3,4	,	3	3	3	3,0	4	15	3	3	2,0.	0,0	о ЭБ	3,5	3,0 .	20	3,4 3 3	20	3	4,0	0	7	3,0	9,0	7	12	12	1,2	a,u	13	4 IU 0 0	0,5	5,0	Ľ	2 .	34 34	2	4	2	,	5 5	5 5	Ľ	4 4	2 2
D02	2 22	0	2,3	2	2,0	2	2,0	20	25	1,0	25	25	20	1,9	3,0	0,0 2.5	3	Ĵ	3,3	20	25	2	0	5	14,0 2 X	0 5	6	У 1	55	,0 Ka	4 26	5	2 3 15 6	0,0	4.0	4	2	0 I 0 A	2	4	2	1	рп	n s		- 4 - 4 - X - 4	2 2
B03	3,32	0	2,3	2	2	2	2,5	20	3,5	2,5	20	2,5	2,0	0,0	3,0	3,5	26	56	3,0. 3,4	20	5	2	5		5.5	10	9	10	10	4,5 0.5	3,0 6	12	50 0 10 10	4,0	9,0		2	24	Ĺ,	1	2	-			2	4	2 1
805	3.96	0	2,0	35	35	2,5	2,5 A	30	25	3,5	3	35	31	0,0	95	3,5 A	35	3	3.9	30	4	4	2 A		0,0	8	6	5	7	25	J A	9	12 13 4 8	6.3	7.0		4 ·	0 4 0 1	4	4	2	\$	5 5	8 8 5 5	4		2 2
B06	3.64	0	31	2	25	1.5	2	20	2,5	3,5	25	3,5	28	0,0	3,5	25	25	3	2.8	30	25	4	1	6.5	35	4	5	45	۶Ľ,	56	4	5	2 5	4.0	50		3	24	1	2	4	2	е е Р Р		2	4	3 1
B07	2.16	n	25	3	3	3	25	29	2	š	15	2	21	0.8	35	35	4 :	35	36	30	5	7	5	<u>``</u>	57	13	10	7	Å	35	5	10	5 10	75	16.0	2	1	4 3		1	3	4	e h	e n	2	4	á 1
BOS	3.96	n	35	ŭ	4	4	4	4n	35	35	35	4	36	0,0	25	35	4	ĩ	35	40	6	10	12	16	110	10	9	6	8 8	33	5	20	9 16	125	60	1	4	2 3	4	1	2	3	s n	n h	1	3	2 4
B09	3.44	0	31	3	3	3	35	31	3	3	35	3	31	00	35	3	3	4	34	20	3	A	6	12	73	5	10	a	11	35	4	7	59	6.3	50	1	2	3 4	4	1	2	3	b p	5 5		4 :	3 2
B10	3.28	n	27	15	2	1	25	18	3	2	2	2	23	0.5	3	š	35 :	35	33	30	5	Ř	6	q	70	12	17	10		25	5	7	а 6 а 6	53	120		2	4 3	2	1	3	ă.	n h		2	4	3 1
B11	3.12	0	16	25	25	25	3	26	15	2	2	3	21	05	35	25	4	4	35	25	3	5	9	9	65	35	7	8	8 8	36	4	7	4 7	55	40	1	2	4 3	3	1	4	2	8 8	2 2	1	4	3 2
B12	392	0	32	3	3	3	3	30	35	4	35	35	36	06	4	35	35 :	25	34	40	7	6	8	9	7.5	7	Я	8	10	33	5	6	4 4	4.8	40	1	2	3 4	4	1	2	3	n s	5 5	2	4	3 1
B13	372	0	33	3	3	25	3	29	0,0	35	3	3	32	03	35	2	35	3	30	30	6	8	12	15	103	4	5	5	5	18	5	6	4 5	50		4	3	1 2	4	1	2	3	s h	5 5	2	4	3 1
B14	2.56	0	2.6	25	2	1	2	1.9	3	3	2	1.5	2.4	0.5	3.5	3.5	3	4	3.5	3.5	2	3	3	5	3.3	5	10	12	9 9	9.0	5	10	87	7.5	8.0	1	2	3 4	4	1	3	2	s s	s s	2	3	4 1
B15	1.96	0	3.4	1.5	1	2	2	1.6	2.5	1	1.5	2.5	1.9	0.3	3	4	3 3	3.5	3.4	3.5	3	4	5	7	4.8	10	7	4	9	7.5	3	4	4 5	4.0	9.0	1	2	3 4	4	1	3	2	s s	s s	2	3 /	4 1
B16	3.76	0	3.6	2.52	25	3	3	28	4	3	25	2.5	3.0	0.2	2.5	4	4	3	3.4	3.0	6	8	8	10	8.0	7	7	3	8 6	5.3	4	5	3 10	5.5	12.0	1	2	4 3	2	1	3	4	s s	s s	3	4 :	2 1
B17	2,52	0	2,6	3	3,5	З	3	3,1	1,5	3,5	3	3	2,8	0,4	2,5	2,5	25	3	2,6	3,0	5	9	8	11	8,3	10	10	10	11 1	0,3	5	7	5 10	6,8	80	1	2	3 4	4	1	3	2	s s	s s	2	з,	4 1
B18	2,64	0	2,1	2	2,5	з	2,5	2,5	2	2,5	1,5	2	2,0	0,5	3	2	3	4	3,0		3	7	5	7	5,5	5	7	9	10 7	7,8	6	10	25 5	11,5	5,0	3	4	1 2	4	з	1	2	h s	p h	2	4 :	3 1
B19	2,32	0	3,1	3	3	3,5	2,5	3,0	3,5	3,5	3,5	2,5	3,3	0,3	3	3	4	3	3,3	3,5	4,5	7	9	9	7,4	6	7	5	6 6	5,0	5,5	9	7 8	7,4	6,0	4	3	1 2	2	1	3	4	s h	h s	2	4 3	3 1
B20	3,72	0	3,2	2,5	2,5	2	2	2,3	1,5	3	1	2	1,9	0,4	3	2,5	1	1	1,9	3,5	5	10	15	20	12,5	10	16	3	18 1	1,8	5	7 3	25 10	6,1	10,0	1	2	3 4	4	1	2	3	h s	S S	4	2 3	3 1
B21	3,24	0	3,1	2	2	1,5	2	1,9	2,5	3,5	3,5	3,5	3,3	1,4	2	2	2,5 :	3,5 :	2,5	3,5	8	8	3	8	6,8	8	5	6	7 6	6,5	4	8	4 10	6,5	7,0	1	3	2 4	4	1	2	3	p s	s h	2	4 :	3 1
B22	4	0	3,7	3	3	3,5	3,5	3,3	3,5	4	3,5	4	3,8	0,5	2,5	2,5	4	3,5	3,1	4,0	5	10	13	10	9,5	10	8	8	12 9	9,5	7	11	5 10	8,3	15,0	1	2	3 4	4	1	2	3			З	1 3	2 4
E01	2,0	0	4,0	3	2,5	2	2	2,4	2	2	1,5	1,5	1,8	0,6	3	3,5	3,5 3	3,5	3,4	3,0	1,5	3	2	3,5	2,5	2,5	4,5	2,5	4 3	3,4	4	11 8	5 6,5	7,0	3,0	1	3	24	3	1	2	4	S S	S S	1	4 :	2 3
E02	4,0	Û	0,0	3,5	3,5	3,5	3,5	3,5	3,5	4	3,5	3,5	3,6	0,1	3,5	3,5	2,5	3,5	3,3	2,5	1	2	2	4	2,3	3	4	2	5 3	3,5	14	22	14 28	19,5	5,0	1	2	4 3	1	2	4	3	p h	h h	1	4 :	2 3
E03	1,0	2	4,0	2,5	3	2	1,5	2,3	2	3	3,5	2	2,6	0,4	3,5	3,5	3,5	3,5	3,5	3,0	2	4	3	4	3,3	2,5	3,5	З	4 3	3,3	3,5	6	2 3	3,6	2,5	1	4	3 2	1	3	4	2	s s	S S	1	з :	2 4
E04	4,0	0	0,0	4	4	3,5	3,5	3,8	4	4	4	4	4,0	0,3	3	3	3,5	4 3	3,4	4,0	2	3,5	2,5	3,5	2,9	5	10	6	7 7	7,0	2	5,5 3	,5 6	4,0	6,0	1	3	24	3	1	4	2	h h	h h	1	3 (4 2
E05	3,0	0	1,0	2,5	2,5	2	2,5	2,4	3,5	3,5	3,5	4	3,6	1,3	2,5	4	3,5	3,5	3,4	4,0	3	4	4	6	4,3	3	4	3	8 4	1,5	6	4	6 11	.6,8	4,0	1	2	34	4	1	2	3	s s	S S	1	4 3	23
E06	4,0	0	2,0	2	3	2	3	2,5	3	3	3	3	3,0	0,5	3,5	4	2,5	3	3,3	4,0	1	2,5	2	2	1,9	1	1,5	0,5	1,5 1	1,1	5	3	6 7	5,3	2,0	1	3	2 4	3	1	4	2	h h	h h	1	3 3	24
E07	3,0	1	4,0	3	3	2,5	2	2,6	3	3,5	2,5	2,5	2,9	0,3	3	3	3	4	3,3	1,0	1,5	2	2	3,5	2,3	2	2	1,5	3 3	2,1	3	4	2 4,5	3,4	2,0	1	3	2 4	2	1	3	4	р р	p p	2	4	1 3
E08	3,0	- 1	4,0	4	4	3,5	4	3,9	4	3,5	4	3	3,6	0,3	3	4	3,5	4 3	3,6	3,5	5	5	4	7	5,3	1,5	3,5	2	5 3	3,0	4	7	6 10	6,8	4,5	1	3	24	4	2	3	1	s s	S S	1	3 2	2 4
E09	2,0	0	3,0	3,5	3,5	3,5	3,5	3,5	3,5	3,5	4	4	3,8	0,3	4	4	4	4	4,0	3,5	2	4	3	6	3,75	2,5	5	3	64,	125	2	5	8,5 8,3	4,7	5	1	2	4 3	4	1	2	3	s s	s s	1	3 :	24
Aver	24		0.0		0.0	0.0	~		0.0	~	0.0	0.0	0.0	0.5	2.0	2.0			2.2							c 0	20								0.7		~ ~		0.0		24	2.2					
ages	3,1	Ų,1	2,8	2,8	2,8	2,6	2,8	2,8	2,8	ડ્રા	28	2,8	2,9	0,5	3,2	3,2	33 3	3,5	3,3	5,2	3,1	0,0	D,/	8,0	5,7	6,2	7,2	5,7 8	<u>51</u> (9,8	4,8	8,3 :	,o 8,6	6,8	6,7	1,6	2,9-3	(1-3,9	3,6	1,4	3,1	3,3			1,9	4,1 3,	1 2,4
B's	3,2	0,0	2,9	2,7	2,7	2,5	2,8	2,7	2,6	3,0	2,5	2,7	2,7	0,5	3,1	3,1	3,3	3,4	3,2	3,2	4,4	6,4	6,9	9,5	6,8	7,7	8,5	6,9	9,5 8	3,1	4,8	8,6 (,7 8,3	6,9	7,9	1,5	2,4 2	,7 3,4	3,3	1,1	2,5	3,0			1,9	3,6 3	0 1,5
E's	2,9	0,4	2,4	3,1	3,2	2,7	2,8	3,0	3,2	3,3	3,3	3,1	3,2	0,4	3,2	3,6	3.3	3,7	3,4	3,2	2,1	3,3	27	4,4	3,1	2.6	4.2	26	1.8	3.6	4,8	7,5 8	4 9.4	16,8	3,8	1,0	2.8 2	7 3.6	2.8	1,4	3,1	2,7			1.1	3.4 2	1 3,3



Results

Overview Introduction Discussion Hypothesis Questionnaire **Results** Conclusions

Finally, we did organize the "non-formal" answers to the non-formal questions:

Query	An	swers
Advantages of	а	Fast and easy
HAND		
	b	Consents improvisations and imperfections
	С	Low cost
	d	Ergonomic
	е	You can move the paper
	f	It does not do what you want not.
	g	Fully accessible everywhere
Advantages of	а	Similar to hand
TABLET	l .	
	b	Clean and precise erasing
	С	Fast
	a	A little bit uncertable
	e f	
		Easy to understand
	y h	Limitless drawing space and includes zeeming facilities
		Worse than hand for fast sketches, and worse than CAD for
		finished drawings
Differences	а	It's more complex to draw with a mouse than with pen
tablet/Mouse	ä	it's more complex to allow with a mouse than with per-
	b	Pen is more precise than mouse.
	C	Pen is more synchronized with cursor than mouse.
	d	Straight lines are easier with mouse than with pen
	е	Curved lines are easier with pen than with mouse
Advantages of	а	Lines are perfect
CAD		
	b	Easy to add geometrical constraints
	С	Easy to dimension
	d	Easy to transform sketches into 3D models
	е	The drawing can be edited a posteriori.
	f	Allows dimensioning / Requires dimensioning
	g	Requires training
Free	а	Tablet is a little bit uncomfortable
oppinions		
	b	Tablet requires more training
	С	Tablet is embarrassing for left-handed.



Overview Introduction Discussion Hypothesis Questionnaire Results **Conclusions** We obtained some conclusions from the general results:

Our attempt to obtain four examples representative of four different levels of difficulty was validated by the arrangement of the respondents

example A was considered the least difficult (average 1.6), example B was the next (2.9), example C was the third (3.1) and example D was rated to be the most difficult (3.9).

We gained an interesting insight in determining what makes sketches more difficult: more curves (1.4); less symmetry (3.1), more angles (3.3) and more lines (3.6).



Overview Introduction Discussion Hypothesis Questionnaire Results **Conclusions** Paper-and-pencil is still considered easier and "handier" than our simulation of a minimalist digital prescriptive sketching tool.

Achieved through Microsoft's Paint limited to just using paintbrush and rubber

Hand drawings achieved similar scores (2.8) to Paint/tablet (2.9), although the execution time was a little bit greater (almost 20%, i.e. from 5.7 to 6.8 minutes)

Respondents achieved similar results, needing more time,

but in an environment completely new to most of them!

Besides, the time was similar to the time required to complete SolidEdge drawings (where most of them had had extensive training)

Overview Introduction Discussion Hypothesis Questionnaire Results **Conclusions** In spite of the above conclusions from the general results...

... we obtained much more interesting oppinions from the non-formal questions.

They are much more interesting because they can guide the contents of the full study that should follow the pilot study!

They are much more interesting because they help us to discover unsuspected aspects of the question!



Overview Introduction Discussion Hypothesis Questionnaire Results **Conclusions** Some respondents considered that the small *uncoupling* between tablet PC's pen and cursor distracts the draftsmen and reduces the accuracy of sketches.

physical separation between pen and cursor

A future taks is exploring whether the uncoupling could be skipped by using other devices.

However, the unfamiliarity of the users with Tablet PCs may have left them disliking them. According to this, the hypothesis to be validated or rejected by future studies should be that in the long run there is little *fundamental* difference between the interface provided by a tablet PC and a piece of paper



Overview Introduction Discussion Hypothesis Questionnaire Results **Conclusions**

The second question addressed was measuring the validity of the belief that

current "pseudo-sketchers" embedded into CAD applications can substitute hand made prescriptive sketches *without loss of usability*, at the time they increase functionality by semi-automatically aiding the user in creating the final model from the different views of the sketch

Respondents seem to put in value the increase of functionality given by SolidEdge, but still notice the loss in usability!



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