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Research Paper

Development and Standardization of Information and Communication Technology Knowledge Scale

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ABSTRACT

The present study was aimed to construct, develop and standardize Information and Communication Technology Knowledge Scale (ICTKS). Investigators outlined the Information and Communication Technology Knowledge Scale (ICTKS) with a thorough reading of the literature and after analysing the content framed 170 items related to the course. The prepared 170 items were revised and edited carefully and then given to the subject experts for their valuable suggestions and corrections to ensure its quality. Thus the content validity of the tool was established. Face validity of the scale was determined on the basis of opinion of the specialists. After first tryout and seeking the opinion of the experts some of the items were reframed and 30 items were deleted. The remaining 140 items were subjected to item analysis. After second tryout 29 items were deleted and 111 items were retained and those items were selected for the final study. Reliability of the questionnaire was 0.86. The predictive and concurrent validity were 0.97 and 0.74. Simple random sampling method was adopted for the selection of 200 samples. Item Analysis was done by calculating the Difficulty Index level and Discrimination Power for each of the 140 items of the pilot study. Mean values (M) were calculated of different variable for grade norms.

Keywords: *Information, Communication, Technology, Difficulty and Discrimination.*

"Good standardized tests must meet the criteria of validity, reliability and usability." -Klausmeier and Goodwin

In the contemporary era, the society has been equipped with a variety of new communication capabilities under the domain of information and communication technology. Many social networking sites like **facebook, twitter, linkedin** etc. allow users around the world to communicate with each other in real time. Similarly, video conferencing, instant messages, voice over internet protocol (VOIP) have removed the place and distance barriers to

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communication. We are living in a **"global village"** where people can communicate across the countries as if they are living next door. ICT can be defined as **"ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form".** Technological advances especially in information sector have significantly changed human life, societies and education. The use of emerging technologies shape learner knowledge creation and transformation processes. According to **G. B. Harrison "ICT may be defined as the use of information in order to meet human need or purpose including reference to the use of contemporary devices such as the internet ".** The age of Information and Communication Technology have emerged and became advanced. The information and communication system, whether networked learning or not, serve a specific media to implement the learning process. The traditional method of teaching is now dominating by the modern method of technologies and it is becoming easy to access for the teacher as well as students also. The use of ICT has been important topic in education. On the one hand, studies have shown that ICT can enhance teaching and learning outcomes. **The 1998 UNESCO world education report, teachers and teaching in a changing world, describes the radical implications ICTs have for conventional teaching and learning. It predicts the transformation of teaching-learning process and the way teachers and learners gain access to knowledge and information.** ICT informs, educates, persuades and entertains with dazzling effects of colour, animation and sound. The use of Information and Communication Technologies (ICTs) for dissemination of education is believed to have huge potential for governments struggling to meet a growing demand for education while facing an escalating shortage of teachers. E-learning may be taken as an electronically carried out learning facilitated and supported by the use of advanced learning technology particularly calling for the services of computers, networking and multimedia. In this content is delivered via the internet, intranet/extranet, audio or video tape, satellite TV and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio. E-learning is an innovative technique or a form of information and communication technology used in providing learning experiences to the students on-line through the use of internet services and web technology of the computers on the same lines as witnessed by us in the form of e-mail, e-banking, e-booking and e-commerce in our day-to-day life. The term e-learning comprises a lot more than online learning, virtual learning, distributed learning, networked or web-based learning. as the letter "e" in e-learning stands for the word "electronic", e-learning would incorporate all educational activities that are carried out by individuals or groups working online or offline, and synchronously or asynchronously via networked or standalone computers and other electronic devices. Other technologies that can enrich education and are being widely used to develop teaching possibilities include, in different combinations: audio, video, computers, telecommunications, distance learning and hypermedia which integrates music, text images, live action video, spoken voices, and animations. These technologies if exploited and implemented effectively can bring sea change in teaching learning process thereby solving many educational problems such as wastage and stagnation, mass failure of students, delinquency and truancy. Schools cannot ignore the impact of technology and the changing face of curriculum. **Anbarsi and**

Nellaiyappen (2014) constructed and standardized an attitude scale on the topic "A Tool Constructed and Standardization of Attitude towards E-learning for higher secondary school students" to measure the attitude of students towards E-learning. In this tool has construct validity as the items were selected using't' value. The face validity of the tool was found by experts in the field of computer science and educational technology. The reliability of the tool was found out with a sample of 100 higher secondary school students using test-retest method and it was found to be 0.83. The percentile norms, Z-score and T-score have been calculated by the investigator for the norms. **Brumini, Spalj, Mavrinac, Biocina-Lukenda; Strujic and Brumini (2014)** undertook a study on a topic entitled "Attitudes towards e-learning amongst dental students at the universities in Croatia" and found that dental students have generally positive attitudes towards e-learning.

Appropriate use of information technology cannot be accomplished without active involvement and support of teachers who are capable of exploiting the profound possibilities that information technology can offer for the teaching-learning process. However, being able to integrate computer technology legitimately requires teachers to have a positive attitude towards technology. Teachers can update their knowledge regarding the latest technology around the world. Hence it is important to find out the level of information and communication technology knowledge of teachers. With the help of Information and Communication Technology Knowledge Scale (ICTKS) we can compare the ICT knowledge among senior secondary school teachers. Therefore investigators decided to make an attempt to construct and standardise the Information and Communication Technology Knowledge Scale (ICTKS) to measure the knowledge of ICT of the senior secondary school teachers.

Statement of the Problem

The problem under study was **"the development and standardization of Information and Communication Technology Knowledge Scale (ICTKS) for senior secondary school teachers".**

Objective of the Study

Following were the main objectives of the study:

1. Selection of Information and Communication Technology Knowledge Scale (ICTKS) items and construct ICTKS for senior secondary school teachers.
2. To standardize Information and Communication Technology Knowledge Scale (ICTKS) for senior secondary school teachers.
3. To establish norms for Information and Communication Technology Knowledge Scale (ICTKS) for senior secondary school teachers.

Delimitations of the Study

The problem is very vast & wide. Hence the investigator has delimited the problem as under:

1. The study was delimited only to senior secondary school teachers only.

2. The area of present study was limited to Almora district and 36 inter colleges were taken for sample.
3. The study was delimited to the sample of 200 senior secondary school teachers.

METHODOLOGY

For the present study the researcher prepared the draft tool, administration of the tool, population selection and sampling methods were as follows:

Population

In the present study all the senior secondary school teachers of Almora district were the population of the study.

Sample

For the present study the researcher adopted **random sampling technique** and selected **200 samples** (130 Male, 70 Female) from the population. Sample were distributed on the basis of sex, residence, location of school, marital status, academic stream, caste, type of school, and teaching experience etc..

Preparation of the Draft Tool

Before constructing the blueprint, the tables were designed indicating weightage to objectives, weightage to content and weightage to type of questions. Keeping the objectives of the study in mind the investigator at first had a complete reading of the Information and Communication Technology through textbook, reference books, journals, magazines, newspaper etc. and made design the tool. In the beginning a list of **170 items** was prepared. The questionnaire had been given to **20 lectures** of senior secondary school to find out whether the data would satisfy their needs of the study. Questionnaire had also been given to the experts in the field. As the scale was interdisciplinary in nature therefore **18 judges** had been chosen from all related fields, i.e., 6 from the Education department, 2 from the Psychology department, 3 from the sociology department, 1 from the economics department, 1 from Hindi department and 5 from the IT department, all from Kumaun University Nainital, S. S. J. Campus, Almora. The experts and judges were requested to critically examine the nature of all the items mentioned in the list and give their opinion regarding suitability of the items. Only those items were retained about which the judges were unanimous for their retention. On the basis of the preliminary try out and experts opinion some items that were dual answered and vague had been reframed and 30 items had been deleted out of 170 and 140 items were included for item analysis. After reframing and deleting the items rest of the items were arranged according to the level of difficulty that is from easy to hard. All the items had been framed in the form of a questionnaire. 140 Multiple Choice Questions prepared with four options (a), (b), (c) and (d), out of which only one is correct and it is given the score value of 1; the other options are incorrect. Thus the preliminary tool was drafted.

Pilot Study: Administration of the Tool

Simple and clear instructions are printed for the examine on the cover page of the test booklet. Although the test can be virtually self-administering, it is always important to establish good "rapport" with the examinees, whether tested individually or in groups. It was ensured that no item of the questionnaire could remain non-responded before the form was collected. It was told to them their responses would be kept strictly confidential. Preliminary tool of Information and Communication Technology knowledge were distributed and tested to the 200 senior secondary school teachers from 36 schools of different areas in Almora district and data was collected. Tests were marked using a standard procedure in which score of +1 was given for each item passed. Thus total 140 marks were assigned for each test. Each question has four answers from which one must be chosen. In case of multiple opinion questions, teachers were instructed to choose only one opinion from provided list of opinions.

Data Analysis and Results

After collecting the data, scoring procedure was simple. 1 mark was awarded to the right answer and 0 mark to wrong answer. The data obtained from 200 teachers were analysed with the help of statistical techniques. Although there are several different process of item analysis giving indices of quality, traditionally two have been used, the difficulty level and the discrimination index. Data analyses were as follows:

Item Analysis

One of the important steps in the standardization of any research tool is an items analysis. It is a statistical technique used for selecting and rejecting the items in a scale on the basis of the obtained values. It is done primarily to eliminate inconsistency of the items. The individual scores for the entire 200 sample were found out. In the present study Item analyses were calculated with the help of Discriminative Power and Difficulty Index.

Discrimination Power (D.P)

The discriminating power (D.P.) of an item indicates the measure of the extent to which an item discriminate or differentiates between subjects do well on the overall test and those who do not do well on the overall test. The discrimination index was determined by the item validity. Item validity was calculated with the help of point bi-serial correlation method. Thus the discriminating power of the item was calculated by the correlation method, point bi-serial formula.

$$r_{pbis} = \frac{(M_p - M_q)_x \sqrt{pq}}{\sigma_{tot}}$$

where r_{pbis} represent point bi-serial correlation coefficient, M_p represent mean of first class, M_q represent mean of second class, p represent ratio of persons in the first class, q represent ratio of persons in the second class and σ_{tot} represent standard deviation of whole group.

Table 1: Showing Item Analysis Results for Discrimination Index

S. N.	r	Level of signi-ficance	Remark	S. N.	r	Level of signi-ficance	Remark
1	0.159	0.05	Selected	2	.361	0.01	Selected
3	-0.008	n.s.*	Rejected	4	0.137	n.s.*	Rejected
5	0.105	n.s.*	Rejected	6	0.264	0.01	Selected
7	0.450	0.01	Selected	8	0.045	n.s.*	Rejected
9	0.106	n.s.*	Rejected	10	0.134	n.s.*	Rejected
11	0.283	0.01	Selected	12	0.045	n.s.*	Rejected
13	0.282	0.01	Selected	14	0.287	0.01	Selected
15	0.010	n.s.*	Rejected	16	0.271	0.01	Selected
17	0.199	0.01	Selected	18	1.37	0.01	Selected
19	0.312	0.01	Selected	20	0.218	0.01	Selected
21	0.306	0.01	Selected	22	0.317	0.01	Selected
23	0.0869	n.s.*	Rejected	24	0.101	n.s.*	Rejected
25	0.245	0.01	Selected	26	0.172	0.05	Selected
27	0.085	n.s.*	Rejected	28	0.233	0.01	Selected
29	0.185	0.01	Selected	30	0.200	0.01	Selected
31	0.118	n.s.*	Rejected	32	0.229	0.01	Selected
33	0.251	0.01	Selected	34	0.288	0.01	Selected
35	0.284	0.01	Selected	36	0.329	0.01	Selected
37	0.321	0.01	Selected	38	0.422	0.01	Selected
39	0.147	0.05	Selected	40	0.308	0.01	Selected
41	0.194	0.01	Selected	42	0.266	0.01	Selected
43	0.321	0.01	Selected	44	0.290	0.01	Selected
45	0.423	0.01	Selected	46	0.262	0.01	Selected
47	0.233	0.01	Selected	48	0.256	0.01	Selected
49	0.491	0.01	Selected	50	0.124	n.s.*	Rejected
51	0.087	n.s.*	Rejected	52	0.254	0.01	Selected
53	0.306	0.01	Selected	54	0.205	0.01	Selected
55	0.827	0.01	Selected	56	0.285	0.01	Selected
57	0.344	0.01	Selected	58	0.146	0.05	Selected
59	0.285	0.01	Selected	60	0.218	0.01	Selected
61	0.659	0.01	Selected	62	0.248	0.01	Selected
63	0.216	0.01	Selected	64	0.358	0.01	Selected
65	0.410	0.01	Selected	66	0.190	0.01	Selected
67	0.242	0.01	Selected	68	0.270	0.01	Selected
69	0.158	0.05	Selected	70	0.326	0.01	Selected
71	0.346	0.01	Selected	72	-0.246	n.s.*	Rejected
73	0.280	0.01	Selected	74	0.308	0.01	Selected
75	0.451	0.01	Selected	76	0.171	0.05	Selected
77	0.286	0.01	Selected	78	0.320	0.01	Selected
79	0.342	0.01	Selected	80	0.199	0.01	Selected
81	0.002	n.s.*	Rejected	82	-0.359	n.s.*	Rejected
83	0.058	n.s.*	Rejected	84	0.056	n.s.*	Rejected
85	0.225	0.01	Selected	86	0.255	0.01	Selected
87	0.176	0.05	Selected	88	0.229	0.01	Selected
89	0.371	0.01	Selected	90	0.380	0.01	Selected
91	0.316	0.01	Selected	92	0.260	0.01	Selected

S. N.	r	Level of signi-ficance	Remark	S. N.	r	Level of signi-ficance	Remark
93	0.314	0.01	Selected	94	0.332	0.01	Selected
95	0.254	0.01	Selected	96	0.295	0.01	Selected
97	0.306	0.01	Selected	98	3.19	0.01	Selected
99	0.317	0.01	Selected	100	0.082	n.s.*	Rejected
101	0.275	0.01	Selected	102	0.274	0.01	Selected
103	0.343	0.01	Selected	104	0.211	0.01	Selected
105	0.065	n.s.*	Rejected	106	0.195	0.01	Selected
107	0.265	0.01	Selected	108	0.263	0.01	Selected
109	0.142	0.05	Selected	110	0.205	0.01	Selected
111	0.156	0.05	Selected	112	0.126	n.s.*	Rejected
113	0.290	0.01	Selected	114	0.275	0.01	Selected
115	0.287	0.01	Selected	116	0.263	0.01	Selected
117	0.329	0.01	Selected	118	0.235	0.01	Selected
119	0.221	0.01	Selected	120	0.219	0.01	Selected
121	0.188	0.01	Selected	122	0.322	0.01	Selected
123	0.364	0.01	Selected	124	0.283	0.01	Selected
125	4.611	0.01	Selected	126	1.366	0.01	Selected
127	0.284	0.01	Selected	128	0.246	0.01	Selected
129	0.260	0.01	Selected	130	0.291	0.01	Selected
131	0.309	0.01	Selected	132	0.482	0.01	Selected
133	0.211	0.01	Selected	134	0.234	0.01	Selected
135	0.316	0.01	Selected	136	0.156	0.05	Selected
137	0.219	0.01	Selected	138	0.277	0.01	Selected
139	0.254	0.01	Selected	140	0.279	0.01	Selected

represents non-significant

Table -1 clearly shows that after calculating discrimination index **118 items** were selected and **22 items** were rejected from **140 items** in the Information and Communication Technology Knowledge Scale (ICTKS).

Difficulty Index (D.I)

The difficulty index (D.I.) of an item is represented by the percentage of students who responded to it correctly. For calculating difficulty level at first we made two groups of data in first group or high achievers group that contains the participants who give true answer and second group or low achievers group that contains the participants who give wrong answer. The numbers of the correct responses in both the groups were counted for each question. For each question the difficulty index was calculated using the **Gilford formula:**

$$Pc = \frac{(R-W/K-1)}{N}$$

where 'Pc' represent the percentage of the teachers knowing the items in real, 'R' represent the percentage of the teachers doing the item right, 'W' stands for the percentage of the

students doing the item wrong, 'N' stands for the total number of teachers in sample, 'K' stands for the number of options in the scale, and 'HR' stands for the number of students who does not attempt items.

Table 2: Showing Item Analysis Results for Difficulty Value

S. N.	Pc	Remark	S. N.	Pc	Remark
1	0.36	Selected	2	0.27	Selected
3	0.18	Rejected	4	0.36	Selected
5	0.24	Selected	6	0.22	Selected
7	0.76	Selected	8	0.89	Selected
9	0.88	Selected	10	0.86	Selected
11	0.23	Selected	12	0.86	Selected
13	0.27	Selected	14	0.41	Selected
15	0.67	Selected	16	0.76	Selected
17	0.25	Selected	18	0.89	Selected
19	0.82	Selected	20	0.85	Selected
21	0.19	Rejected	22	0.84	Selected
23	0.24	Selected	24	0.83	Selected
25	0.24	Selected	26	0.31	Selected
27	0.84	Selected	28	0.84	Selected
29	0.88	Selected	30	0.83	Selected
31	0.56	Selected	32	0.21	Selected
33	0.70	Selected	34	0.23	Selected
35	0.203	Selected	36	0.85	Selected
37	0.88	Selected	38	0.81	Selected
39	0.32	Selected	40	0.84	Selected
41	0.88	Selected	42	0.83	Selected
43	0.86	Selected	44	0.28	Selected
45	0.87	Selected	46	0.80	Selected
47	0.88	Selected	48	0.80	Selected
49	0.28	Selected	50	0.79	Selected
51	0.80	Selected	52	0.34	Selected
53	0.83	Selected	54	0.85	Selected
55	0.28	Selected	56	0.21	Selected
57	0.67	Selected	58	0.65	Selected
59	0.28	Selected	60	0.73	Selected
61	0.20	Selected	62	0.80	Selected
63	0.73	Selected	64	0.75	Selected
65	0.85	Selected	66	0.93	Rejected
67	0.81	Selected	68	0.93	Rejected
69	0.87	Selected	70	0.76	Selected
71	0.22	Selected	72	0.80	Selected
73	0.84	Selected	74	0.85	Selected
75	0.88	Selected	76	0.28	Selected
77	0.36	Selected	78	0.21	Selected
79	0.84	Selected	80	0.28	Selected

S. N.	Pc	Remark	S. N.	Pc	Remark
81	0.70	Selected	82	0.84	Selected
83	0.84	Selected	84	0.87	Selected
85	0.63	Selected	86	0.22	Selected
87	0.73	Selected	88	0.40	Selected
89	0.84	Selected	90	0.36	Selected
91	0.90	Selected	92	0.84	Selected
93	0.84	Selected	94	0.88	Selected
95	0.89	Selected	96	0.89	Selected
97	0.92	Rejected	98	0.90	Selected
99	0.78	Selected	100	0.16	Rejected
101	0.17	Rejected	102	0.81	Selected
103	0.74	Selected	104	0.31	Selected
105	0.86	Selected	106	0.85	Selected
107	0.84	Selected	108	0.23	Selected
109	0.20	Selected	110	0.22	Selected
111	0.28	Selected	112	0.81	Selected
113	0.86	Selected	114	0.80	Selected
115	0.73	Selected	116	0.64	Selected
117	0.28	Selected	118	0.85	Selected

Table-2 clearly shows that after calculating difficulty value for each item **7 items** were rejected and only 111 items were selected from 118 items in the Information and Communication Technology Knowledge Scale (ICTKS).

Item Selection

The items were evaluated and selected with the help of difficulty value index and discrimination power of items. The discrimination power and difficulty Index of the preliminary draft tool were given in the table-1 and table-2. In the present investigation, only those items whose difficulty index (D.I.) ranged from 20% to 90% (Aggarwal, 2014-15, P. 98) and whose discrimination power (r_{pbis} value) falls above 0.138 at 0.05 level of significance and 0.181 at 0.01 level of significance were selected and the rest of the items were not selected for the final study. Thus the final version of Information and Communication Technology Knowledge Scale (ICTKS) had only 111 items.

Reliability of the Scale

Reliability is a general term that describes a class of statistical techniques addressing the precision of a scale. Split-half reliability was computed on a sample of 200 lecturers which was found 0.86 by Spearman Brown formula. It justified that the Information and Communication Technology Knowledge Scale (ICTKS) was a reliable tool.

Validity of the Scale

When the items were written as per the blueprint, after revision, the tool was given to senior secondary school teachers, IT teacher, teacher educators, research scholar and judgements.

The suggestions, modifications and evaluation by experts and judges confirm its **face and content validity.** The process of item analysis also ensures **item validity** of the scale. The **predictive validity** was computed by the product moment method which was 0.97. **Concurrent validity** was 0.74 which was calculated by discrimination method in which we use point bi-serial method. Thus these values shows constructed and standardized ICTKS was valid.

Norms for the Scale

A norm represents a typical level of performance for a particular group. Norms are empirically established by determining what persons in a representative group actually do on a test. It is required to establish norms for all those variables which had significant effect on the outcome of the test raw score. In the present study **mean values** (M) were calculated of different variable for **grade norms.** The investigator of the present study framed and computed the grade norms in respect of the sample for different variables as follows:

Table 3: Showing Norms for the Scale

Variable/Class	Type	Grade Norms (M)
Gender	Male	99
	Female	108
Location of school	Rural	100
	Urban	105
Type of school	Private	103
	Government	98
	Aided	97
Caste	Upper	100
	Lower	99
Academic Stream	Art	102
	Science	111
	Commerce	100
Residence	Rural	98
	Urban	106
Type of post	Permanent	98
	Temporary	110
Family Monthly Income	30000	101
	30000-700000	103
	Above 70000	99
Marital Status	Married	100
	Unmarried	112
Teaching Experience	1-10 Year	110
	10-20 Year	98
	Above 20 Year	80
Type Of Family	Nuclear	103
	Joint	105
Number Of Family Member	Below 4	102
	Above 4	104
Mother's	Class 1-12th	105

Variable/Class	Type	Grade Norms (M)
Qualification	Above Class 12th	102
Father's Qualification	Class 1-12th	104
	Above Class 12th	102
Total	**32**	**102**

DISCUSSION

An effort was made to select those items which were considered interesting according to judgment of the researcher in order to reduce unwanted variation in performance resulting from poor motivation or flagging attention. Those items were selected which were considered neither very easy nor very difficult. The predictive validity and Concurrent validity were 0.97 and 0.74. Thus these values shows constructed and standardized ICTKS was valid. The reliability was found 0.86 which shows that ICTKS is reliable. The difficulty level is related to the difficulty of the item in terms of percentage of the students doing the item right. The large the difficulty level the easier the item, the smaller the difficulty level the more difficult the item. Most items have points bi-serial correlation values were higher than 1.81 which shows that mostly items were highly discriminating power or highly valid. The items which have difficulty Index value (Pc by Gilford's formula) between the ranges 0.20 to 0.90 were selected. Most items have difficulty Index value between the ranges 0.20 to 0.90 which shows that mostly items were average difficulty level.In the present study mean values (M) were calculated of different variable for grade norms.

CONCLUSION

In the present study all thesenior secondary school teachers of Almora district were the population of the study and researcher adopted **random sampling technique** and selected **200 samples** from the population and 36 inter colleges were taken for sample.The predictive validity and Concurrent validity was 0.97 and 0.74. In starting tool was given to senior secondary school teachers, IT teacher, teacher educators and judgements. The given suggestions and modifications by the experts were carried out and thereby content validity was established. The reliability was found 0.86. Point bi-serial correlation values of the most items were higher than 1.81 and most items have difficulty index (D. I.) value between the ranges 0.20 to 0.90.In the beginning, a list of **170 items** was prepared. The list was presented to a group of research scholars, 20 lectures and finally 18 judges and only those items were retained about which the judges were unanimous for their retention. This led to elimination of 30 items out of 170. The remaining 140 items were subjected to item analysis. After calculating discrimination index **118 items** were selected and **22 items** were rejected from **140 items** in the ICTKS. On the basis of difficulty value **7 items** were rejected and only 111 items were selected from 118 items. After item analysis **111 items** were retained in the Information and Communication Technology Knowledge Scale (ICTKS) for the final format. The total **grade norms** value was **102.**Thus the constructed and standardized ICTKS was valid and reliable. The selected 111 items were printed in a booklet form with necessary instructions.

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Conflict of Interest

The authors colorfully declare this paper to bear not conflict of interests

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