



University of Essex

# Commission Type, Gender and Cap-badge in Officer Education



University of Essex, Army Education Project

Authors: Dr James Fowler  
Abdullahi Ishola

Presented for Discussion at  
the Royal Military Academy: 17 Sep 20

Publication date: 06 Nov 20

Version: 1.3

# Table of contents

<b>Table of contents</b> .....	<b>2</b>
<b>Acknowledgements</b> .....	<b>3</b>
<b>Terminology</b> .....	<b>3</b>
<b>Aim</b> .....	<b>3</b>
<b>Executive Summary</b> .....	<b>4</b>
<b>Background</b> .....	<b>4</b>
<b>Sample and Methodology</b> .....	<b>4</b>
<b>Statistical Test Results</b>	
Late Entry / Direct Entry.....	5
Male / Female.....	5
Cap-badge.....	5
<b>Numerical Results</b>	
Grades Awarded by Commission Type, Gender and Cap-badge.....	6
Grades Awarded by Assessment Category.....	6
Average Scores Ranked by Cap-badge.....	7
<b>Summary</b> .....	<b>8</b>
<b>Recommendations</b> .....	<b>8</b>
<b>Appendices</b>	
A - Late Entry / Direct Entry T-tests.....	10
B - Male / Female T-tests .....	13
C - Cap-badge Analysis of Variances tests.....	16

# Acknowledgements

I would like to thank the Ministry of Defence and the Faculty of Social Sciences for their support in this project. I would also like to thank Major Ben Holden (18 AEC) for his kind assistance in gathering the data, Mr Abdullahi Ishola (Accounting and Finance Group) for his work on statistical analysis and Lieutenant-Colonel Caroline Emmett for her comments which were of significant assistance in reviewing the report.

## Terminology

Analysis of Variance (ANOVA)-test – An analysis tool that splits an observed aggregate variability found inside a data set into two parts: systematic factors and random factors. The systematic factors have a statistical influence on the given data set, while the random factors do not.

Cap-badge – Functional specialisation and/or Regimental affiliation within the Army.<sup>1</sup>

AAC – Army Air Corps.

ETS – Educational and Training Services.

GDS – The Guards Infantry Battalions.

INF – All other Infantry Battalions.

INT CORPS – Intelligence Corps.

PARA – The Parachute Battalions.

PQO – Professionally Qualified Officer (e.g. Dentist, Doctor, Lawyer).

R SIGS – Royal Signals.

RA – Royal Artillery.

RAMC – Royal Army Medical Corps.

RE – Royal Engineers,

REME – Royal Electrical and Mechanical Engineers.

RLC – Royal Logistic Corps.

RMP – Royal Military Police.

SPS – Staff and Personnel Support.

Confidence Level – The percentage of all possible samples that can be expected to include the true population parameter. A typical industry level is 95%.

Direct Entry (DE) – Officers who joined the Army as Officer Cadets and became commissioned Officers after one year at the Royal Military Academy Sandhurst.

Late Entry (LE) – Officers who joined the Army as soldiers and became commissioned Officers later in their careers.

MA(A) and MA(B) – Two week long military analysis courses undertaken by all Officers prior to promotion to Major covering the Application of Force and International Relations.

OJAR – Officers' Joint Annual Report. An annual appraisal of an Officer's overall performance. Grades are typically 'B-' to 'A-' but may include 'A' and Where Talent Endures (WTE) recommendations.

OT – Officer Tutor. An ETS Officer with a PGCE and an MSc in Educational Practice who delivers MA modules alongside an Academic from the Royal Military Academy.

T-test – A type of inferential statistic used to determine if there is a significant difference between the means of two groups, which may be related in certain features. It is used as a hypothesis testing tool, which allows testing of an assumption applicable to a population.

---

<sup>1</sup> The following list is indicatively but not directly related to Cap-badge.

# Aim

This study identifies whether statistically significant relationships exist between Officers' commission type, gender and cap-badge and their performance on Military Analysis courses.

## Executive Summary

1. Being an LE or DE Officer has a very significant relationship with results.
2. Being male or female has no significant relationship with results.
3. Cap-badges have a very significant relationship with results.
4. The average Officer scores between 'Proficient' and 'Merit' overall on an MA course.
5. No Officers were awarded a 'Weak' grade.

## Background

The Army collects detailed data on the individual scores and backgrounds of Officers when they complete two Military Analysis (MA) modules as part of their stage one career pipeline. These week-long courses are essential for promotion to Major for all Officers, with a very few exceptions, across the whole Army. Officers complete the modules between roughly four and eight years into their career at the rank of Captain. Prior to attending an MA course, Officers will have completed the Junior Officer Leadership Programme and potentially Junior Command and Staff College. These prepare them in terms of their analytical thinking and their verbal and written communication skills for the MA modules. They are taught by a teaching staff made up of military educators (Officer Tutors at the rank of Major) from the ETS branch of the Army and academics from the Royal Military Academy Sandhurst. The content of MA courses is entirely humanities based.

There has been speculation amongst the module deliverers about the impact, if any, of the characteristics assessed in this study on Officers' performance. The reasons for the salience of these issues may be surmised as follows: (1) The Army is an amalgamation of many smaller organisational components with strong identities and proud traditions. (2) There are two distinct types of commissioned Officer. Those who joined as soldiers, typically non-graduates and those, typically graduates, who became Officers directly. (3) In the past two decades the Army has dramatically expanded the number of roles open to women, though they are a minority within the organisation as a whole. This study examines whether these characteristics are significant in one specific area of an Officer's career progression. In the short term the project could have practical impact on classroom delivery methods. In the longer term it should help to review assessment design. Theoretically it may enhance the Army's understanding of unconscious bias, an area of significant MoD interest at present, and specifically how it manifests itself in the classroom. It can also make a contribution to theories of classroom management and cultural expectations of learners within institutions.

## Sample and Methodology

The study sampled the results of 410 students for Cap-badge and Commission type and 99 results for gender drawn from an equal distribution of all UK Army Education Centres between January and December 2019. In the Army as a whole there is an overall population of ca. 3000 Officers at the MA career stage. This gives 95% and 90% confidence levels respectively. Although the significance of gender would benefit from more research from a larger sample, the ratios of male/female in the sample accurately reflected overall organisational ratios. The five grade descriptors used on the course ('Weak' 'Developing' 'Proficient' 'Merit' and 'Distinction') have been given corresponding numerical scores of 1, 2,3 ,4 and 5 to allow quantitative analysis. These analyses consist of the T-test and ANOVA-test to discern whether variations are significantly attributable to hypotheses proposed. The remaining numerical data sets are

interpreted using simple averages. An important limiting factor to consider in this methodology is that it does not take account of explanations other than Gender, Commission type or Cap-badge impacting on outcomes. Until wider research is conducted other hypotheses cannot be discounted. Widening the scope to include age, minority status and educational background would significantly enhance the results.

## Statistical Test Results

### Late Entry / Direct Entry

The Significance of Commission Type to Assessment Results		
Assessment	T-test	Significance
Assimilate Information	0.0445	5%< Significant
Analysis	0.0060	1% Highly significant
Conceptual Thinking	0.0001	1%< Exceptionally significant
Application	0.0092	1% Highly significant
Written Articulation	0.0002	1%< Exceptionally significant
Verbal Articulation	0.0000	1%< Exceptionally significant
Combined	0.0002	1%< Exceptionally significant

The significance of an Officer's commission type to their results is very high in almost every respect. The numerical results provide more detail in terms of comparative grade bandings.

### Male / Female

The Significance of Gender to Assessment Results		
Assessment	T-test	Significance
Assimilate Information	0.55	20%> No significance
Analysis	0.13	10%> Very limited significance
Conceptual Thinking	0.71	20%> No significance
Application	0.78	20%> No significance
Written Articulation	0.25	20%> No significance
Verbal Articulation	0.47	20%> No significance
Combined	0.36	20%> No significance

Gender is an insignificant factor in assessment results.

### Cap-badge

The Significance of Capbadge to Assessment Results		
Assessment	ANOVA-test	Significance
Assimilate Information	0.0295	5%< Significant
Analysis	0.0022	1%< Exceptionally significant
Conceptual Thinking	0.0086	1% Highly significant
Application	0.5244	20%> No significance
Written Articulation	0.0766	10%< Limited significance
Verbal Articulation	0.0021	1%< Exceptionally significant
Combined	0.0007	1%< Exceptionally significant

Cap-badge is generally a very significant factor in assessment results, with one exception: Officers are perceived to work equally hard. However, within this general observation about performance there are some exceptionally significant differences in performance listed as follows:

1. Assimilate Information. The ETS (high) and the RE (low).
2. Analysis. The INT CORPS (high) relative to the RA, RAMC, REME and RLC (low).

3. Conceptual Thought. The INT CORPS (high) relative to all other Cap-badges except RAC, ETS, PARA, R SIG, RMP and SPS (also high).

4. Verbal Articulation. The INT CORPS (high) relative to the INF, RA, RAMC and RLC (low).

## Numerical Results

### Grades Awarded by Age, Gender and Cap-badge

Filter	Weak	Developing	Proficient	Merit	Distinction
All	0%	5%	45%	43%	6%
LE	0%	15%	55%	26%	4%
DE	0%	4%	44%	45%	7%
Male	0%	5%	36%	56%	3%
Female	0%	3%	56%	41%	0%
AAC	0%	6%	50%	39%	5%
All INF + GDS + PARA	0%	5%	42%	44%	8%
ETS	0%	0%	15%	73%	12%
GDS	0%	5%	52%	32%	12%
INF	0%	6%	40%	46%	8%
INT CORPS	0%	1%	19%	58%	22%
PARA	0%	4%	45%	45%	6%
PQO	0%	5%	50%	38%	8%
R SIGS	0%	3%	40%	56%	1%
RA	0%	7%	50%	40%	3%
RAC	0%	6%	39%	46%	10%
RAMC	0%	6%	49%	41%	3%
RE	0%	5%	46%	44%	5%
REME	0%	6%	60%	30%	4%
RLC	0%	7%	51%	38%	4%
RMP	0%	2%	53%	38%	7%
SPS	0%	5%	58%	33%	3%

The most prominent feature is that no Officer in the entire sample was awarded a 'Weak' grade. Other points of interest are as follows:

1. LE Officers were awarded almost four times as many 'Developing' grades as the average Officer. ETS Officers were awarded no developing grades at all.
2. No Female Officers were awarded a 'Distinction'.
3. Three-quarters of the grades awarded to ETS Officers were 'Merits'.
4. INT CORPS Officers gained three times as many 'Distinctions' as the average Officer and roughly twice as many as their nearest comparators.

## Grades Awarded by Assessment Category

Grade	Assimilate Information	Analysis	Conceptual Thought	Application	Written Articulation	Verbal Articulation
<b>Weak</b>	0%	0%	0%	0%	0%	0%
<b>Developing</b>	0%	4%	12%	0%	13%	3%
<b>Proficient</b>	41%	44%	56%	37%	48%	45%
<b>Merit</b>	51%	46%	29%	57%	32%	45%
<b>Distinction</b>	8%	6%	4%	6%	7%	7%

As previously, the most prominent feature is that no 'Weak' grades were awarded. Other points of interest are as follows:

1. Conceptual thought and written articulation show the greatest spread of marks. Conceptual thought is a relatively high order cognitive function in Bloom's Taxonomy and essay writing is not extensively practised prior to the MA modules.

2. No 'Weak' or 'Developing' scores were awarded in assimilating information and application. This is as expected given prior training and that that these are relatively low order cognitive functions.

## Average Scores Ranked by Cap-badge

Cap-badge/Filter	Rank	Score
INT CORPS	1	4.02
ETS	2	3.97
RAC	3	3.60
INF	4	3.57
All INF + GDS + PARA	5	3.56
R SIGS	6	3.56
PARA	7	3.54
The Average Officer	8	3.53
GDS	9	3.50
RMP	10	3.50
PQO	11	3.49
RE	12	3.48
The Average Officer Excluding ETS & INT CORPS	13	3.47
AAC	14	3.42
RAMC	15	3.41
RA	16	3.39
RLC	17	3.38
SPS	18	3.35
REME	19	3.32

INT CORPS and ETS Officers score appreciably higher than all their peers, though note that both Corps have graduate entry requirements. This is illustrated by the difference between ETS and RAC Officers (0.37) which is greater than the entire variance of the remaining Cap-badges (0.28). It is also demonstrated by the effect of excluding INT CORPS and ETS Officers from the average. The low average score of REME Officers may be speculatively attributed to the humanities rather than science based content of the MA courses.

# Summary

1. Being an LE or DE Officer has a very significant relationship with results.
2. Being male or female has no significant relationship with results.
3. Cap-badges have a very significant relationship with results.
4. The average Officer scores between 'Proficient' and 'Merit' overall on an MA course.
5. No Officers were awarded a 'Weak' grade.
6. No 'Weak' or 'Developing' grades were awarded in either Assimilating Information or Application.
7. 78% of 'Developing' grades are awarded in the areas of conceptual thought and written articulation.
8. All Cap-badges are judged to work equally hard.
9. INT CORPS and ETS Officers' average combined grades are separated from all other Cap-badges by a degree greater than the entire variance in the remainder.
10. LE Officers were awarded almost four times as many 'Developing' grades as the average Officer.

There is an absence of gender imbalance in the results and the majority of Officers are viewed as 'Proficient' or above in most respects. The LE/DE split is palpable, though the root causes of this are not accounted for here. The grade range is not being fully used, especially in assimilation and application, and the weaknesses in written articulation and conceptual thought may make themselves felt by participants in the Army Higher Education programme.

## Recommendations

These recommendations should be interpreted in the light of the restrictions in the scope of this study mentioned in the methodology. This study tests the effects of gender, commission type (age) and cap-badge on an individual's performance. It does not assess other hypotheses such as age, previous educational attainment, background IQ or quality of instruction on a module. As such, the evidence used here is limited and therefore indicative rather than conclusive. Nevertheless, these results have, and should continue, to form the basis of a more in-depth discussion through a series of Continuous Professional Development meetings between Officer Tutors and Academics. They allow the opportunity to change aspects of the modules and teaching style without necessarily altering content or aims.

1. Review the use/purpose of the 'Weak' grade. It is not used, so is its purpose purely positional? There should be an open discussion amongst practitioners about what circumstances would lead them to award a 'Weak' grade.
2. Review course preparation for LE Officers. There is a very clear discrepancy here which warrants further investigation (see point 6). It is likely that the root causes of the phenomenon go beyond the Army itself, but there are some measures which may allow some voluntary participation in activities designed to close the gap, especially for LE Officers interested in going to Staff College.
3. Review the opportunities to identify OJAR A / WTE level students. A lot of focus has been on assisting and identifying less prepared Officers. However, the Army is also interested in identifying the very able. The process by which this is communicated should be re-visited to ensure that First and Second Reporting Officers are clearly informed about their high achievers.
4. Written articulation and conceptual thought have the highest number of developing grades and the greatest spread of marks overall. This indicates that some Officers will struggle with the Army Higher Education Pathway (AHEP). Proposals (1) Practitioners should be conversant with the Henley Business School (Reading University) marking scheme so that their assessments and feedback are congruent with



---

Officer' expectations and experience of assignments on the AHEP. (2) Review the assessments of conceptual thought and written articulation on the courses, noting that demonstrating the higher intellectual faculties in Bloom's Taxonomy challenges all Officers and the very short duration of the courses presents severe challenges for deliverers. Nevertheless, there may be scope for adjusting the ways in which essay writing is introduced, conceptual thought explained and to review the conditions under which it is assessed to make them more congruent with the AHEP.

5. A more extensive qualitative study into LE Officer education. The difference between DE and LE performance is wide ranging and not sufficiently addressed in this study. There should be a subsequent in-depth study with the co-operation of RMAS to properly understand this phenomenon and offer realistic advice about what might be achieved. This study would draw on the RMAS records into Officer Education and interviews with practitioners and LE Officers to qualitatively assess what subjects' and experts' opinions of the issue are and how it might be resolved.

# Appendices

## Appendix A Late Entry / Direct Entry T-Sample Tests

### Assimilate Information Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
1	374	3.692513	.0320882	.6205572	3.629417	3.75561
2	36	3.472222	.1014663	.6087979	3.266235	3.67821
combined	410	3.673171	.0307154	.6219397	3.612791	3.733551
diff		.2202911	.1064193		.0056365	.4349458

diff = mean(1) - mean(2) t = 2.0700

Ho: diff = 0 Welch's degrees of freedom = 42.7268

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9777 Pr(|T| > |t|) = 0.0445 Pr(T > t) = 0.0223

### Analysis Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
1	374	3.569519	.034255	.6624605	3.502162	3.636876
2	36	3.194444	.1248456	.7490735	2.940994	3.447894
combined	410	3.536585	.0334787	.6778926	3.470774	3.602397
diff		.3750743	.1294597		.1135776	.6365709

diff = mean(1) - mean(2) t = 2.8972

Ho: diff = 0 Welch's degrees of freedom = 40.7568

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9970 Pr(|T| > |t|) = 0.0060 Pr(T > t) = 0.0030

### Conceptual Thinking Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
1	374	3.28877	.0353994	.6845927	3.219163	3.358378
2	36	2.75	.1219875	.7319251	2.502352	2.997648
combined	410	3.241463	.0348014	.7046737	3.173052	3.309875
diff		.5387701	.12702		.2823351	.795205

diff = mean(1) - mean(2) t = 4.2416

Ho: diff = 0 Welch's degrees of freedom = 41.4635

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9999 Pr(|T| > |t|) = 0.0001 Pr(T > t) = 0.0001

### Application Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
1	374	3.684492	.0296658	.5737092	3.626159	3.742825
2	36	3.694444	.0961104	.5766625	3.49933	3.889559
combined	410	3.685366	.0283117	.573268	3.629711	3.74102
diff		-.0099525	.1005847		-.2128913	.1929864

diff = mean(1) - mean(2)

t = -0.0989

Ho: diff = 0

Welch's degrees of freedom = 42.3464

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 0.4608

Pr(|T| > |t|) = 0.9216

Pr(T > t) = 0.5392

### Written Articulation Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
1	374	3.382353	.0404562	.7823857	3.302802	3.461904
2	36	2.861111	.1205331	.7231984	2.616416	3.105806
combined	410	3.336585	.0390378	.7904553	3.259846	3.413325
diff		.5212418	.1271414		.2649637	.7775199

diff = mean(1) - mean(2)

t = 4.0997

Ho: diff = 0

Welch's degrees of freedom = 43.7489

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 0.9999

Pr(|T| > |t|) = 0.0002

Pr(T > t) = 0.0001

### Verbal Articulation Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
1	374	3.590909	.0345381	.6679349	3.522995	3.658823
2	36	3.166667	.0845154	.5070926	2.995091	3.338242
combined	410	3.553659	.0328828	.6658258	3.489018	3.618299
diff		.4242424	.0913003		.2406957	.6077891

diff = mean(1) - mean(2)

t = 4.6467

Ho: diff = 0

Welch's degrees of freedom = 48.2519

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 1.0000

Pr(|T| > |t|) = 0.0000

Pr(T > t) = 0.0000

## Combined Score

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
1	374	3.534759	.0254223	.4916439	3.48477	3.584748
2	36	3.189815	.0791692	.4750151	3.029093	3.350537
combined	410	3.504472	.0246587	.4993003	3.455998	3.552945
diff		.3449446	.0831508		.1772524	.5126367

diff = mean(1) - mean(2)

t = 4.1484

Ho: diff = 0

Welch's degrees of freedom = 42.9767

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 0.9999

Pr(|T| > |t|) = 0.0002

Pr(T > t) = 0.0001

## Appendix B – Male / Female T-Sample Tests

### Assimilate Information Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
f	11	3.454545	.1574592	.522233	3.103705	3.805386
m	88	3.556818	.0556569	.5221079	3.446194	3.667442
combined	99	3.545455	.0523076	.5204536	3.441652	3.649257
diff		-.1022727	.1670062		-.4626389	.2580934

diff = mean(f) - mean(m) t = -0.6124

Ho: diff = 0 Welch's degrees of freedom = 13.154

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 0.2754

Pr(|T| > |t|) = 0.5507

Pr(T > t) = 0.7246

### Analysis Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
f	11	3.272727	.1408358	.4670994	2.958926	3.586529
m	88	3.522727	.0685292	.6428613	3.386518	3.658937
combined	99	3.494949	.0631962	.6287944	3.369539	3.62036
diff		-.25	.1566237		-.5816658	.0816658

diff = mean(f) - mean(m) t = -1.5962

Ho: diff = 0 Welch's degrees of freedom = 16.2175

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 0.0649

Pr(|T| > |t|) = 0.1297

Pr(T > t) = 0.9351

### Conceptual Thinking Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
f	11	3.272727	.1408358	.4670994	2.958926	3.586529
m	88	3.329545	.0620142	.5817451	3.206285	3.452805
combined	99	3.323232	.0571217	.5683539	3.209876	3.436589
diff		-.0568182	.1538846		-.3847808	.2711444

diff = mean(f) - mean(m) t = -0.3692

Ho: diff = 0 Welch's degrees of freedom = 15.0182

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 0.3586

Pr(|T| > |t|) = 0.7171

Pr(T > t) = 0.6414

## Application Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
f	11	3.636364	.15212	.504525	3.297419	3.975308
m	88	3.590909	.0551344	.5172065	3.481323	3.700495
combined	99	3.59596	.0516062	.5134754	3.493549	3.69837
diff		.0454545	.1618033		-.3032377	.3941468

diff = mean(f) - mean(m) t = 0.2809  
 Ho: diff = 0 Welch's degrees of freedom = 13.3241

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.6085 Pr(|T| > |t|) = 0.7831 Pr(T > t) = 0.3915

## Written Articulation Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
f	11	3	.1906925	.6324555	2.575111	3.424889
m	88	3.25	.0812166	.7618791	3.088573	3.411427
combined	99	3.222222	.0753683	.7499055	3.072656	3.371788
diff		-.25	.2072674		-.6926355	.1926355

diff = mean(f) - mean(m) t = -1.2062  
 Ho: diff = 0 Welch's degrees of freedom = 14.6743

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.1234 Pr(|T| > |t|) = 0.2468 Pr(T > t) = 0.8766

## Verbal Articulation Grade

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
f	11	3.727273	.1408358	.4670994	3.413471	4.041074
m	88	3.613636	.0569877	.5345923	3.500367	3.726906
combined	99	3.626263	.052921	.5265571	3.521243	3.731283
diff		.1136364	.1519286		-.2118034	.4390762

diff = mean(f) - mean(m) t = 0.7480  
 Ho: diff = 0 Welch's degrees of freedom = 14.1928

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.7667 Pr(|T| > |t|) = 0.4667 Pr(T > t) = 0.2333

## Combined Score

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
f	11	3.393939	.0754539	.2502524	3.225818	3.562061
m	88	3.477273	.045411	.4259928	3.387013	3.567532
combined	99	3.468013	.0412169	.4101025	3.38622	3.549807
diff		-.0833333	.0880651		-.2671048	.1004381

diff = mean(f) - mean(m)

t = -0.9463

Ho: diff = 0

Welch's degrees of freedom = 19.8803

Ha: diff < 0

Ha: diff != 0

Ha: diff > 0

Pr(T < t) = 0.1777

Pr(|T| > |t|) = 0.3554

Pr(T > t) = 0.8223

## Appendix C – Cap-badge Analysis of Variances Tests

### Assimilate Information Grade

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between groups	11.2925411	17	.664267126	1.77	0.0295
Within groups	146.912337	392	.37477637		
Total	158.204878	409	.386808993		

Bartlett's test for equal variances:  $\chi^2(16) = 12.7598$  Prob> $\chi^2 = 0.690$

### Analysis Grade

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between groups	17.180459	17	1.01061524	2.32	0.0022
Within groups	170.77076	392	.435639695		
Total	187.95122	409	.459538434		

Bartlett's test for equal variances:  $\chi^2(16) = 9.8934$  Prob> $\chi^2 = 0.872$

### Conceptual Thinking Grade

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between groups	16.5364322	17	.972731306	2.04	0.0086
Within groups	186.55869	392	.475915025		
Total	203.095122	409	.49656509		

Bartlett's test for equal variances:  $\chi^2(17) = 17.1866$  Prob> $\chi^2 = 0.442$

### Application Grade

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between groups	5.27479368	17	.310281981	0.94	0.5244
Within groups	129.137401	392	.329432147		
Total	134.412195	409	.328636174		

Bartlett's test for equal variances:  $\chi^2(15) = 15.6701$  Prob> $\chi^2 = 0.404$

### Written Articulation Grade

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between groups	16.0343206	17	.943195332	1.54	0.0766
Within groups	239.516899	392	.611012497		
Total	255.55122	409	.624819608		

Bartlett's test for equal variances:  $\chi^2(16) = 22.1731$  Prob> $\chi^2 = 0.138$



## Verbal Articulation Grade

Source	Analysis of Variance			F	Prob > F
	SS	df	MS		
Between groups	16.6611626	17	.980068388	2.33	0.0021
Within groups	164.65835	392	.42004681		
Total	181.319512	409	.443323991		

Bartlett's test for equal variances:  $\chi^2(16) = 15.9835$  Prob> $\chi^2 = 0.454$

## Combined Score

Source	Analysis of Variance			F	Prob > F
	SS	df	MS		
Between groups	10.1551866	17	.59736392	2.55	0.0007
Within groups	91.808835	392	.234206212		
Total	101.964022	409	.249300786		

Bartlett's test for equal variances:  $\chi^2(17) = 17.2275$  Prob> $\chi^2 = 0.439$